



WORK ORDER NO. 1562331
Contract NO. N40085-20-F6271

SPECIFICATIONS FINAL SUBMISSION

NOAA OMAO Ship & Support Facility Relocation

NAVFAC MIDLANT Design and Construction Business Line, Norfolk, VA

PREPARED BY:



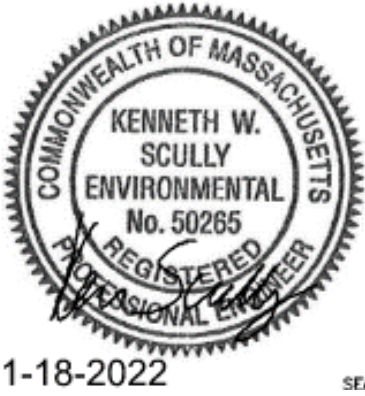



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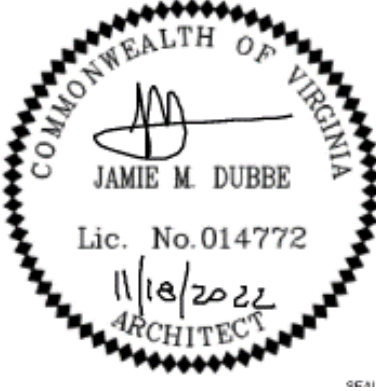





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1.1 SUMMARY

This section lists the drawings for the project pursuant to contract clause "DFARS 252.236-7001, Contract Drawings, Maps and Specifications."

1.2 CONTRACT DRAWINGS

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417	12874293	EG117	PIER - GROUNDING PLAN - AREA G
418	12874294	EG118	PIER - GROUNDING PLAN - AREA H
419	12874295	EG140	ADMIN / WAREHOUSE - GROUNDING & LIGHTNING PROTECTION
420	12874296	EG501	ADMIN / WAREHOUSE - GROUNDING DETAILS
421	12874297	EG502	PIER - GROUNDING RISER DIAGRAM
422	12874298	E-601	PIER - SINGLE LINE DIAGRAM
423	12874299	E-641	ADMIN / WAREHOUSE - SINGLE LINE DIAGRAM
424	12874300	E-642	ADMIN / WAREHOUSE - SINGLE LINE FEEDERS SCHEDULE
425	12874301	E-710	PIER - PANELBOARD SCHEDULES
426	12874302	E-711	PIER - PANELBOARD SCHEDULES
427	12874303	E-741	ADMIN / WAREHOUSE - PANELBOARD SCHEDULES
428	12874304	E-742	ADMIN / WAREHOUSE - PANELBOARD SCHEDULES
429	12874305	E-743	ADMIN / WAREHOUSE - PANELBOARD SCHEDULES
430	12874306	E-744	ADMIN / WAREHOUSE - PANELBOARD SCHEDULES
431	12874307	E-745	ADMIN / WAREHOUSE - PANELBOARD SCHEDULES
432	12874308	E-746	ADMIN / WAREHOUSE - PANELBOARD SCHEDULES
433	12874309	E-770	BOAT REPAIR - PANELBOARD SCHEDULES
434	12874310	EC301	CATHODIC PROTECTION SECTIONS
435	12874311	EC302	CATHODIC PROTECTION DETAILS
436	12874312	EC501	CATHODIC PROTECTION DETAILS
437	12874313	EC601	CATHODIC PROTECTION TABLES
TELECOMMUNICATIONS			
438	12874314	TN001	NETWORKING LEGEND, ABBREVIATIONS AND GENERAL NOTES

439	12874315	TS501	SITE DETAILS
440	12874316	TS502	SITE DETAILS
441	12874317	TS503	SITE DETAILS
442	12874318	TG501	GROUNDING DETAILS
443	12874319	TG502	GROUNDING DETAILS
444	12874320	TG701	GROUNDING RISER
445	12874321	TN111	PIER - NETWORKING PLAN - AREA A AND B
446	12874322	TN112	PIER - NETWORKING PLAN - AREA C
447	12874323	TN113	PIER - NETWORKING PLAN - AREA D
448	12874324	TN114	PIER - NETWORKING PLAN - AREA E
449	12874325	TN115	PIER - NETWORKING PLAN - AREA F
450	12874326	TN116	PIER - NETWORKING PLAN - AREA G
451	12874327	TN141	ADMIN / WAREHOUSE - NETWORKING PLAN VIEW - FIRST FLOOR - AREA A
452	12874328	TN142	ADMIN / WAREHOUSE - NETWORKING PLAN VIEW - FIRST FLOOR - AREA B
453	12874329	TN143	ADMIN/WAREHOUSE - NETWORKING PLAN VIEW - SECOND FLOOR
454	12874330	TN170	BOAT REPAIR - NETWORKING PLAN
455	12874331	TN181	BUILDING 76 - BASEMENT FLOOR PLAN & ELEVATION
456	12874332	TN182	BUILDING 76 - FIRST FLOOR PLAN & ELEVATION
457	12874333	TN191	BUILDING 1318 - FIRST FLOOR PLAN & ELEVATION
458	12874334	TN211	PIER - SECTIONS
459	12874335	TN241	ADMIN / WAREHOUSE - NETWORKING ELEVATIONS
460	12874336	TN242	ADMIN / WAREHOUSE - NETWORKING ELEVATIONS
461	12874337	TN243	ADMIN / WAREHOUSE - NETWORKING ELEVATION
462	12874338	TN244	ADMIN / WAREHOUSE - NETWORKING ELEVATION
463	12874339	TN441	ADMIN / WAREHOUSE - NETWORKING ENLARGED PLANS
464	12874340	TN501	NETWORKING DETAILS
465	12874341	TN502	NETWORKING DETAILS
466	12874342	TN503	NETWORKING DETAILS
467	12874343	TN504	NETWORKING DETAILS
468	12874344	TN505	NETWORKING DETAILS

469	12874345	TN506	NETWORKING DETAILS
470	12874346	TN507	NETWORKING DETAILS
471	12874347	TN508	NETWORKING DETAILS
472	12874348	TN641	ADMIN / WAREHOUSE - NETWORKING SCHEDULES
473	12874349	TN741	ADMIN / WAREHOUSE - NETWORKING ONE-LINES AND RISERS
474	12874350	TN742	ADMIN / WAREHOUSE - NETWORKING ONE-LINES AND RISERS
475	12874351	TY001	SPECIAL SYSTEMS LEGEND AND NOTES
476	12874352	TY111	PIER - SECURITY PLAN VIEWS
477	12874353	TY141	ADMIN/WAREHOUSE - SPECIAL SYSTEMS PLAN VIEW - AREA A
478	12874354	TY142	ADMIN/WAREHOUSE - SPECIAL SYSTEMS PLAN VIEW - AREA B
479	12874355	TY143	ADMIN/WAREHOUSE - SPECIAL SYSTEMS PLAN VIEW - SECOND FLOOR
480	12874356	TY241	ADMIN/WAREHOUSE - SPECIAL SYSTEMS ELEVATIONS
481	12874357	TY501	SPECIAL SYSTEMS DETAILS
482	12874358	TY502	SPECIAL SYSTEMS DETAILS
483	12874359	TY503	SPECIAL SYSTEMS DETAILS
484	12874360	TY741	ADMIN / WAREHOUSE - CCTV ONE-LINES AND SCHEDULES
485	12874361	TY742	ADMIN / WAREHOUSE - ONE-LINE AND RISER DIAGRAMS
AUDIO / VISUAL			
486	12874362	TA001	LEGEND, ABBREVIATIONS, AND GENERAL NOTES
487	12874363	TA141	ADMIN / WAREHOUSE - AUDIOVISUAL PLAN - FIRST FLOOR - AREA A
488	12874364	TA142	ADMIN / WAREHOUSE - AUDIOVISUAL PLAN - FIRST FLOOR - AREA B
489	12874365	TA143	ADMIN / WAREHOUSE - AUDIOVISUAL PLAN - SECOND FLOOR
490	12874366	TA151	ADMIN / WAREHOUSE - AUDIOVISUAL CEILING PLAN - FIRST FLOOR - AREA A
491	12874367	TA152	ADMIN / WAREHOUSE - AUDIOVISUAL CEILING PLAN - SECOND FLOOR
492	12874368	TA441	ADMIN / WAREHOUSE - AUDIOVISUAL DISPLAY ELEVATIONS

493	12874369	TA442	ADMIN / WAREHOUSE - AUDIOVISUAL DISPLAY ELEVATIONS
494	12874370	TA443	ADMIN / WAREHOUSE - AUDIOVISUAL DISPLAY ELEVATIONS
495	12874371	TA501	AUDIOVISUAL PLATE AND PANEL DETAILS
496	12874372	TA502	AUDIOVISUAL DISPLAY BACK BOX DETAILS
497	12874373	TA503	AUDIOVISUAL CAMERA BACK BOX DETAILS
498	12874374	TA504	AUDIOVISUAL SPEAKER DETAILS
499	12874375	TA741	ADMIN / WAREHOUSE - AV LARGE CONFERENCE ROOM 113 LINE DRAWING
500	12874376	TA742	ADMIN / WAREHOUSE - AV SMALL CONFERENCE ROOM 202 LINE DRAWING
501	12874377	TA743	ADMIN / WAREHOUSE - AV TECH LIBRARY/ HUDDLE 112 LINE DRAWING
502	12874378	TA744	ADMIN / WAREHOUSE - AV EXEC SUITE HUDDLE ROOM 120 LINE DRAWING
503	12874379	TA745	ADMIN / WAREHOUSE - AV EXEC SUITE SOUND MASKING LINE DRAWING
504	12874380	TA746	ADMIN / WAREHOUSE - AV EXEC SUITE SOUND MASKING CONTROL BOX ELEVATION

1.3 SUPPLEMENTARY DRAWINGS

These supplementary drawings may not be a part of the contract but are included with the drawings for information.

1.3.1 Reference Drawings

The following reference drawings are intended only to show the original construction. Drawings are the property of the Government and shall not be used for any purpose other than that intended by the contract.

DWG NO.	PROJECT TITLE	SHEET TITLE
P.W. 3634-45	NAVAL SUPPLY DEPOT AT CODDINGTON COVE	PIER AND PIER HEAD
Y&D 529896	COLD STORAGE PLANT	GRADING AND UNDERGROUND SERVICE PLAN
Y&D 529898	COLD STORAGE PLANT	SITE DETAILS - SHEET NO. 1
Y&D 529899	COLD STORAGE PLANT	SITE DETAILS - SHEET NO. 2
Y&D 529900	COLD STORAGE PLANT	BREAKWATER & DREDGING PLAN & DETAILS

Y&D 529901	COLD STORAGE PLANT	WHARF PLAN & DETAILS
Y&D 529902	COLD STORAGE PLANT	RAILROAD SIDING PLAN, PROFILE & DETAILS
Y&D 529903	COLD STORAGE PLANT	PILE PLAN - SECTION I
Y&D 529904	COLD STORAGE PLANT	PILE PLAN - SECTION II
Y&D 529905	COLD STORAGE PLANT	FOUNDATION & FLOOR FRAMING PLAN SECTION I
Y&D 529906	COLD STORAGE PLANT	FOUNDATION & FLOOR FRAMING PLAN SECTION II
Y&D 529913	COLD STORAGE PLANT	FOUNDATION DETAILS - SHEET NO. 1 COLD STORAGE AREA
Y&D 529914	COLD STORAGE PLANT	FOUNDATION DETAILS - SHEET NO. 2 COLD STORAGE AREA
Y&D 529915	COLD STORAGE PLANT	FOUNDATION DETAILS - SHEET NO. 3 OFFICE & MACHINE ROOM AREA
Y&D 835,031	REPAIRS TO CATHODIC PROTECTION SYSTEM FOR STEEL WATERFRONT B'LK'H'D AT B'LD'G NO. 42	
NUWC 19-002A (SHEET 3)	BUILDING 11 HVAC RETROFIT	M-2 PARTIAL FLOOR PLAN - HVAC NEW WORK
NUWC 19-002A (SHEET 8)	BUILDING 11 HVAC RETROFIT	E-1 PARTIAL FLOOR PLAN - ELECTRICAL
NUWC 19-002A (SHEET 9)	BUILDING 11 HVAC RETROFIT	E-2 LEGEND, NOTES AND DETAILS - ELECTRICAL
NUWC 18-08A (SHEET 6)	COLLABORATIVE WORKSPACE BUILDING 11	A-5 NEW REFLECTED CEILING PLAN
NUWC 18-08A (SHEET 15)	COLLABORATIVE WORKSPACE BUILDING 11	E-2 NEW ELECTRICAL POWER PLAN
NUWC 18-08A (SHEET 20)	COLLABORATIVE WORKSPACE BUILDING 11	E-7 PANEL SCHEDULES
NUWC 21-049A (SHEET 7)	PARKING LOT REPAVING BUILDING 11	CS101 SITE PLAN

1.3.2 Boring Logs

The Government does not guarantee that borings indicate actual conditions, except for the exact locations and the time that they were made. Subsurface data, not specified or indicated, have been obtained by the Government at this station. The data are available for examination by prospective bidders in the office of the Contracting Officer .

1.3.3 Subsurface Data

Subsurface data, not specified or indicated, have been obtained by the Government at the station. The data are available for examination by prospective bidders at the station. The soils report is included as part of the solicitation.

-- End of Document --

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SECTION 01 11 00

SUMMARY OF WORK
08/15

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

1.2 WORK COVERED BY CONTRACT DOCUMENTS

1.2.1 Project Description

This project supports the relocation of four NOAA vessels and support personnel, and includes waterfront work, shore-side buildings, and shore-side support areas. The waterfront work includes pier construction and a four-berth pier, trestle, floating dock and bulkhead replacement.

The supporting land-based includes facilities, with associated parking, exterior storage, and adjacent laydown area and incidental related work. The project includes the Pier Landing site (adjacent to the current "T" pier and building number 6 along the shoreline) as the primary site location, and a secondary site for 50-space parking lot developed near Building 11.

The project is provided with Base Bid and Bid Options to support the available construction budget.

Base Bid includes construction of:

- Admin/warehouse building
- Pier Landing Site and Utilities landing to the site
- Bulkhead

Bid Options includes construction of:

- Bid Option - Pier and trestle
- Bid Option - Small boat facility
- Bid Option - Hazmat container
- Bid Option - Floating dock
- Bid Option - Bldg 11 site parking and utilities

1.2.2 Location

The work is located within an Installation Restoration (IR) site (in-water and landside), at the Naval Station Newport, Rhode Island, approximately as indicated. The exact location will be shown by the Contracting Officer.

Refer to USACE EM 385 Section 33, for safety requirements, Land Use Control (LUC), and Record of Decision (RD) for Site 19 Operable Unit 12, on-shore, and Operable Unit 5, off-shore, for lists of contaminants,

engineering controls, handling of soil, groundwater and sediment, and other requirements.

1.3 EXISTING WORK

In addition to FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements:

- a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.
- b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the completion of operations, existing work must be in a condition equal to or better than that which existed before new work started.

1.4 LOCATION OF UNDERGROUND UTILITIES

Obtain digging permits prior to start of excavation, and comply with Installation requirements for locating and marking underground utilities. Contact local utility locating service a minimum of 48 hours prior to excavating, to mark utilities, and within sufficient time required if work occurs on a Monday or after a Holiday. Verify existing utility locations indicated on contract drawings, within area of work.

Identify and mark all other utilities not managed and located by the local utility companies. Scan the construction site with Ground Penetrating Radar (GPR), electromagnetic, or sonic equipment, and mark the surface of the ground or paved surface where existing underground utilities are discovered. Verify the elevations of existing piping, utilities, and any type of underground or encased obstruction not indicated, or specified to be removed, that is indicated or discovered during scanning, in locations to be traversed by piping, ducts, and other work to be conducted or installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

1.4.1 Notification Prior to Excavation

Notify the Contracting Officer at least 15 days prior to starting excavation work.

1.5 GOVERNMENT-INSTALLED WORK

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 14 00

WORK RESTRICTIONS
11/11, CHG 11: 11/20

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

List of Contact Personnel

1.2 SPECIAL SCHEDULING REQUIREMENTS

- a. Permission to interrupt any Activity roads, railroads, or utility service must be requested in writing a minimum of 15 calendar days prior to the desired date of interruption.
- b. The work under this contract requires special attention to the scheduling of the work in connection with Navy and USCG waterfront operations. Identify on the construction schedule each factor which constitutes a potential interruption to Pier Access Road operations.
- c. The International Seapower Symposium (ISS) is held every 2 years at Pier 2 and is scheduled September 2023 and 2025. The Contractor will not be able to perform any work on the contract from September 9th to September 20th, 2023 and September 7th to September 22th, 2025. The work site shall be clean up to the best extent possible.
- d. Any boats or barges to be brought into the restricted water of Naval Station Newport to perform the work on this contract shall provide 96-hour notification to the Contract Officer.
- e. For all dive operations the contractor must notify the Contracting Officer 96-hours in advance.
- f. Notify the Contracting Officer at least 48-hours prior to starting any phase of work including, excavation, in-water work, turbidity curtain installation, rip-rap removal, sheet piles installation, pile driving, etc.
- g. Coordination with National Grid is required for the gas line installation. The contractor is responsible for the excavation, sand bedding, backfill, and final restoration including concrete meter pad in accordance with the National Grid trenching requirements. National Grid is responsible for the installation of the piping.
- h. No in-water work shall begin until all related permits are received.

1.3 CONTRACTOR ACCESS AND USE OF PREMISES

1.3.1 Activity Regulations

Ensure that Contractor personnel employed on the Activity become familiar with and obey Activity regulations including safety, fire, traffic and security regulations. Keep within the limits of the work and avenues of ingress and egress. Wear appropriate personal protective equipment (PPE) in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. Mark Contractor equipment for identification.

1.3.1.1 Subcontractors and Personnel Contacts

Provide a list of contact personnel of the Contractor and subcontractors including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.3.1.2 Installation Access

Obtain access to Navy installations through participation in the Defense Biometrics Identification System (DBIDS). Requirements for Contractor employee registration, and transition for employees currently under Navy Commercial Access Control System (NCACS), are available at <https://www.cnlic.navy.mil/om/dbids.html>. No fees are associated with obtaining a DBIDS credential.

Participation in the DBIDS is not mandatory, and Contractor personnel may apply for One-Day Passes at the Base Visitor Control Office to access an installation.

1.3.1.2.1 Registration for DBIDS

Registration for DBIDS is available at <https://www.cnlic.navy.mil/om/dbids.html>. Procedure includes:

- a. Present a letter or official award document (i.e. DD Form 1155 or SF 1442) from the Contracting Officer, that provides the purpose for access, to the base Visitor Control Center representative.
- b. Present valid identification, such as a passport or Real ID Act-compliant state driver's license.
- c. Provide completed SECNAV FORM 5512/1 to the base Visitor Control Center representative to obtain a background check. This form is available for download at <https://www.cnlic.navy.mil/om/dbids.html>.
- d. Upon successful completion of the background check, the Government will complete the DBIDS enrollment process, which includes Contractor employee photo, fingerprints, base restriction and several other assessments.
- e. Upon successful completion of the enrollment process, the Contractor employee will be issued a DBIDS credential, and will be allowed to proceed to worksite.

1.3.1.2.2 DBIDS Eligibility Requirements

Throughout the length of the contract, the Contractor employee must continue to meet background screen standards. Periodic background screenings are conducted to verify continued DBIDS participation and installation access privileges. DBIDS access privileges will be immediately suspended or revoked if at any time a Contractor employee becomes ineligible.

An adjudication process may be initiated when a background screen failure results in disqualification from participation in the DBIDS, and Contractor employee does not agree with the reason for disqualification. The Government is the final authority.

1.3.1.2.3 DBIDS Notification Requirements

- a. Immediately report instances of lost or stolen badges to the Contracting Officer.
- b. Immediately collect DBIDS credentials and notify the Contracting Officer in writing under the following circumstances:
 - (1) An employee has departed the company without having properly returned or surrendered their DBIDS credentials.
 - (2) There is a reasonable basis to conclude that an employee, or former employee, might pose a risk, compromise, or threat to the safety or security of the Installation or anyone therein.

1.3.1.2.4 One-Day Passes

Personnel applying for One-Day passes at the Base Visitor Control Office are subject to daily mandatory vehicle inspection, and will have limited access to the installation. The Government is not responsible for any cost or lost time associated with obtaining daily passes or added vehicle inspections incurred by non-participants in the DBIDS.

1.3.1.3 No Smoking Policy

Smoking is prohibited within and outside of all buildings on installation, except in designated smoking areas. This applies to existing buildings, buildings under construction and buildings under renovation. Discarding tobacco materials other than into designated tobacco receptacles is considered littering and is subject to fines. The Contracting Officer will identify designated smoking areas.

1.3.2 Working Hours

Regular working hours will consist of an 8 1/2 hour period , between 7 a.m. and 3:30 p.m., Monday through Friday, excluding Government holidays.

1.3.3 Work Outside Regular Hours

Work outside regular working hours requires Contracting Officer approval. Make application 15 calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number and project title. Based on the justification provided, the Contracting Officer may approve work outside regular hours. During

periods of darkness, the different parts of the work must be lighted in a manner approved by the Contracting Officer.

1.3.4 Utility Cutovers and Interruptions

- a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays. Conform to procedures required in paragraph WORK OUTSIDE REGULAR HOURS.
- b. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.
- c. Interruption to water, sanitary sewer, storm sewer, telephone service, electric service, air conditioning, heating, fire alarm, compressed air, and gas are considered utility cutovers pursuant to the paragraph WORK OUTSIDE REGULAR HOURS.
- d. Operation of Station Utilities: The Contractor must not operate nor disturb the setting of control devices in the station utilities system, including water, sewer, electrical, and steam services. The Government will operate the control devices as required for normal conduct of the work. The Contractor must notify the Contracting Officer giving reasonable advance notice when such operation is required.
- e. Connection to Existing Sanitary Sewer Line: Provide positive verification that the existing line conveys sanitary sewer; verify line is not incorrectly connected to a storm drain. Obtain Installation's Sanitary Sewer Connection Permit 2 weeks prior to connection and in accordance with Section 33 30 00 SANITARY SEWERAGE.
- f. Natural Gas: Provide excavation, backfill and restoration per the drawings and per the attached National Grid Service Agreement from National Grid Gas Service. PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --



Exhibit A to Commercial Service/Main Agreement

July 26, 2021

Michael Brice – Supervisory Contract Specialist
NAVFAC SYSCOM Mid-Atlantic
9324 Virginia Ave
Norfolk, VA 23511

Re: NOAA Facility Naval Station Newport 00 Defense Hwy Newport – Gas Service

Dear Mr Brice,

I am pleased to inform you that your request for installation of natural gas service has been evaluated and provisionally approved for approximately 3000 CFH of natural gas at 10.0" w.c. outlet meter delivery pressure as the primary fuel for your buildings.

Final approval constituting an agreement by National Grid to proceed with the requested installation will require you to complete and return the attached Commercial Gas Service Agreement. Once executed by National Grid, the accepted Agreement shall become the agreement governing the proposed installation.

To adequately supply natural gas to this project, it will require installation of;

Main – Approx 1000' of new 4" PE 10 PSI
Boat House – 150' of new 1 1/8" PE 10 PSI service (75 CFH)
Generator – 140' of new 2" PE 10 PSI service (2400 CFH)
Main Facility – 50' of new 1 1/8" PE 10 PSI service (765 CFH)

Please confirm supply meets design requirements.

Customers' contractor (at customers' expense) has agreed to provide trenching, padding sand, backfill, and final restoration on private property for the service. National Grid will be responsible for installation of the pipe (Reference Exhibit C).

This project will require a Contribution in aid of Construction (CIAC) in the amount of

██████████

Please complete and return the signed Application. Please be advised that the contribution in aid of construction is subject to change at any time.

This agreement is also subject to the following:

- 1) **All outlet piping after the meter is the sole responsibility of the owner.**
- 2) **All equipment (if needed) must be properly regulated to operate correctly and safely at the above stated delivery pressure.**
- 3) **All equipment must be installed according to any national, state or local codes.**
- 4) **Approval is contingent upon being able to obtain any needed state or local permits by National Grid.**
- 5) **Price does not include any occurrences causing a delay in installation**
- 6) **Final meter location must have a minimum 3 foot clearance on all sides from operable windows, doors, vents and sources of ignition (electrical)**

- 7) Normal meter configuration from the riser is left to right.
- 8) In the event that a concrete pad is required for the meter installation, said pad must be poured per National Grid Specifications by the customer at their expense.
- 9) National Grid is not responsible for final restoration on private property.

Please be advised that all projects are assigned an estimated target date only after the needed permits are received and the project has been dig-safed.

Please email a signed copy of the enclosed agreement to my attention at

Thomas Dion
thomas.dion@nationalgrid.com
National Grid
477 Dexter St
Providence RI 02907

Please be sure that the service line agreement is completed in full including your signature.

Your application will be processed upon receipt of the contract. If the enclosed application is not signed and received within three (3) months from the date of this letter, this provisional approval and the contribution amount will have to be reconsidered.

Once your contract has been processed further information regarding service line or meter install can be obtained from Mario Carlino Project Manager. He can be reached at mario.carlino@nationalgrid.com

Average lead time for service installations is 12-14 weeks after the receipt of the signed service line installation agreement. All installations are subject to weather conditions, work loads and the ability to procure a road opening permit from the town, city or state, whichever is applicable.

We cannot accept the meter application order for service activation until the natural gas service pipe and equipment installations are completed, including the outlet piping tied into the meter that will be installed in the off and locked position or the applicable header bar(s), whichever is applicable. Meter activation application, when ready, can be made by calling our contact center at 1-800-870-1664.

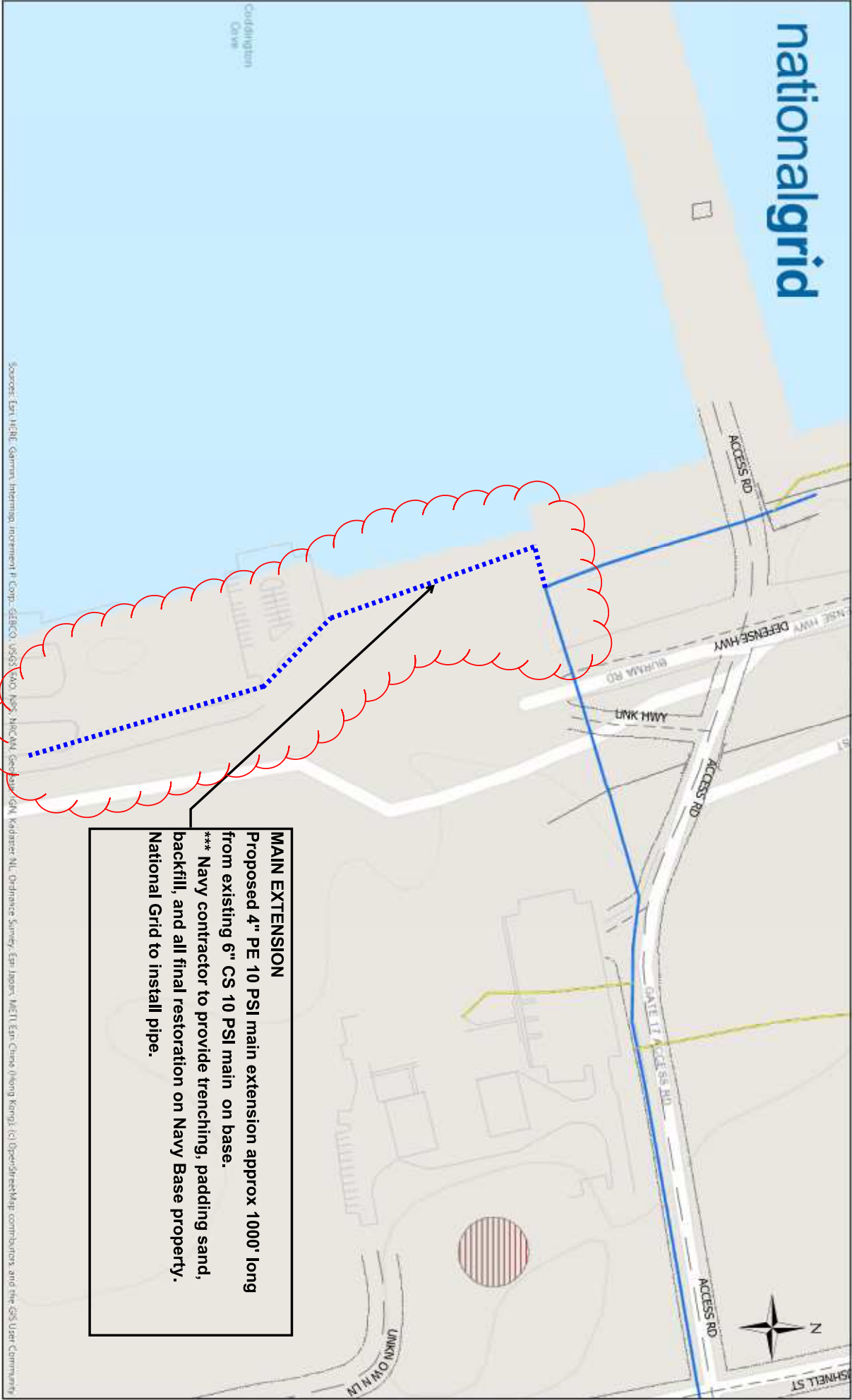
If I can be of further assistance, please contact me direct at (401) 784-7153.

Sincerely,

Thomas Dion

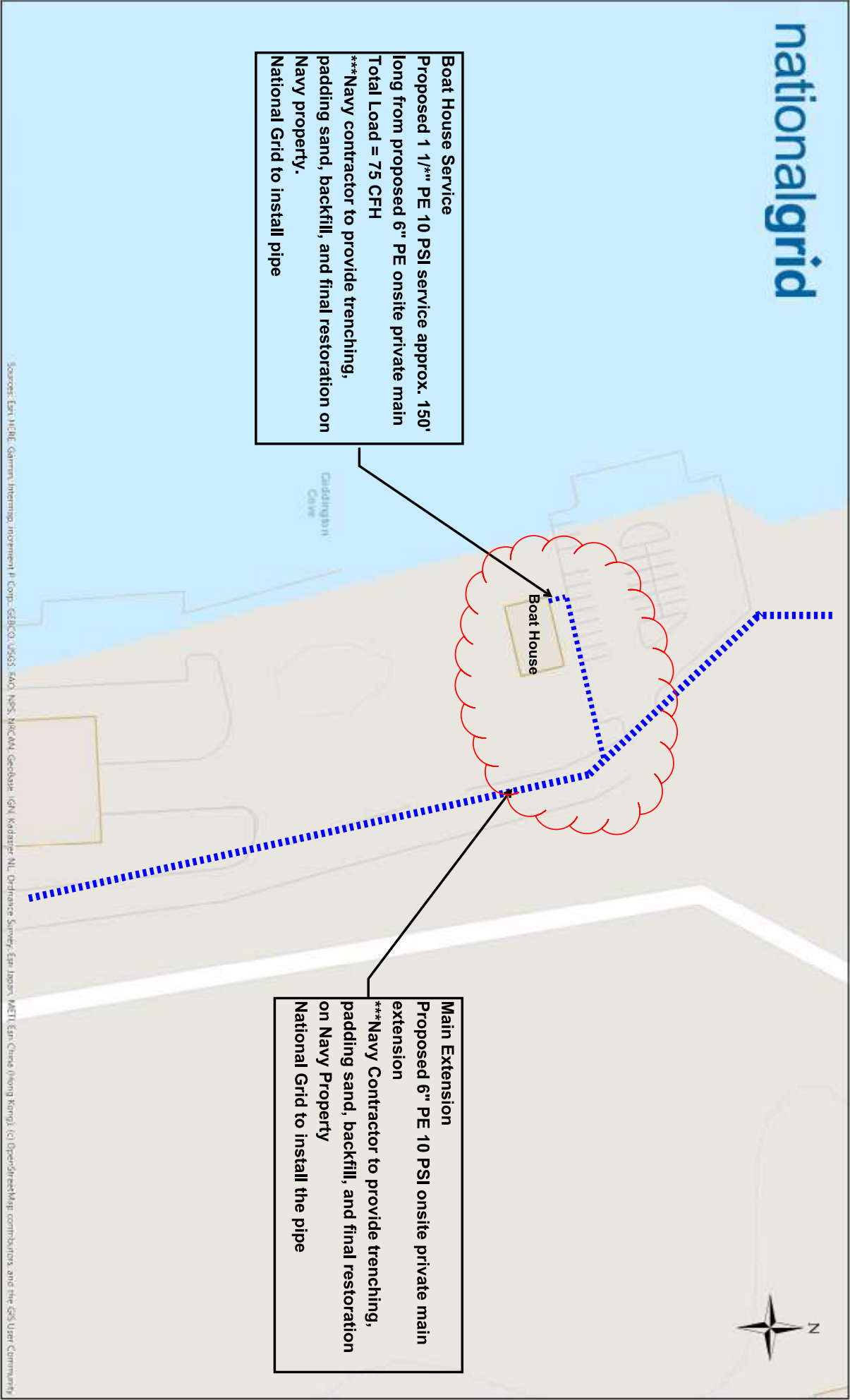
Enclosure(s)/attachments

EXHIBIT B



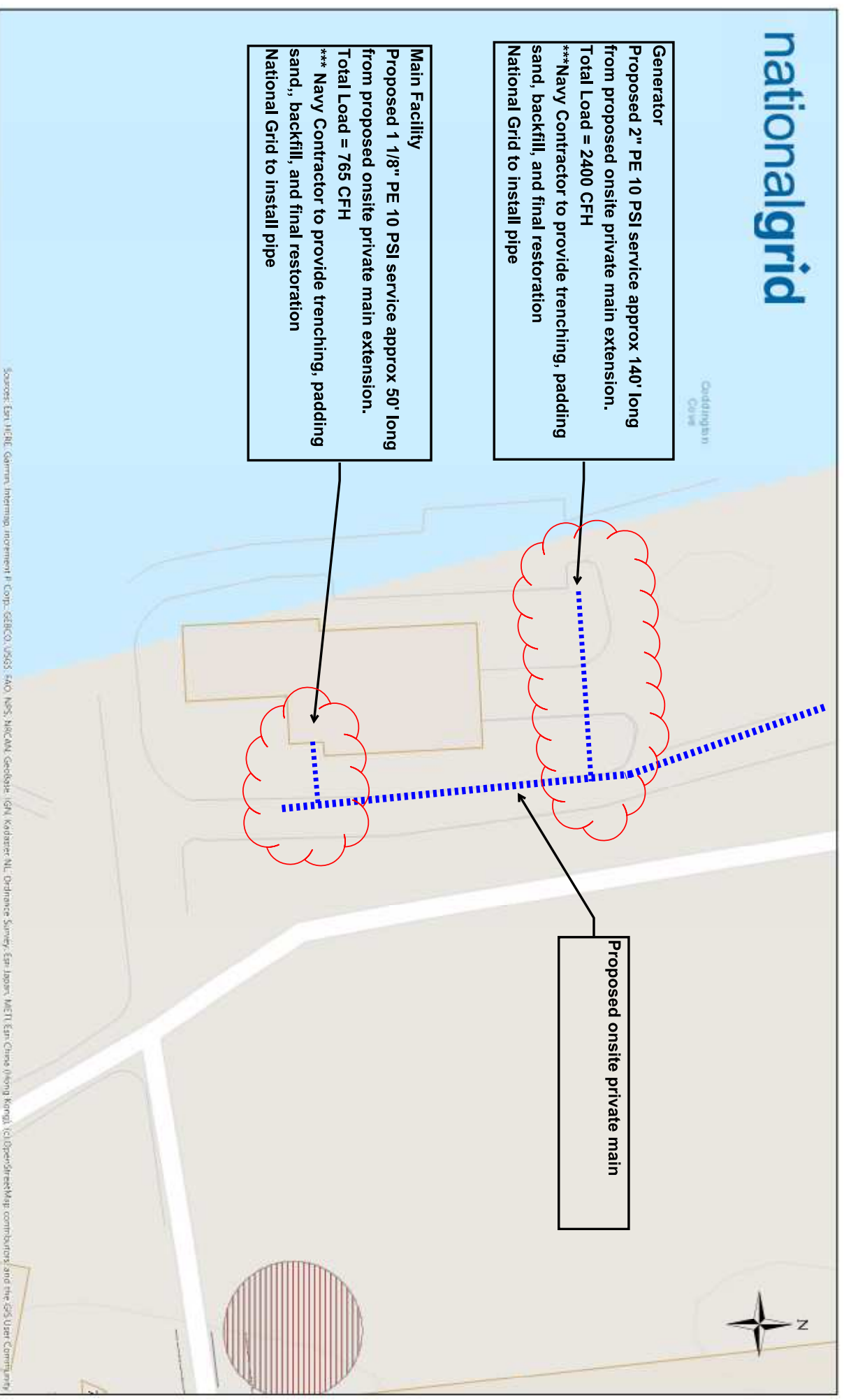
NOAA - Naval Station Newport - Main Extension

EXHIBIT C



NOAA Naval Station Newport - Boat House

EXHIBIT D



Contractor Trenching Requirements

Rhode Island

Customer Obligations

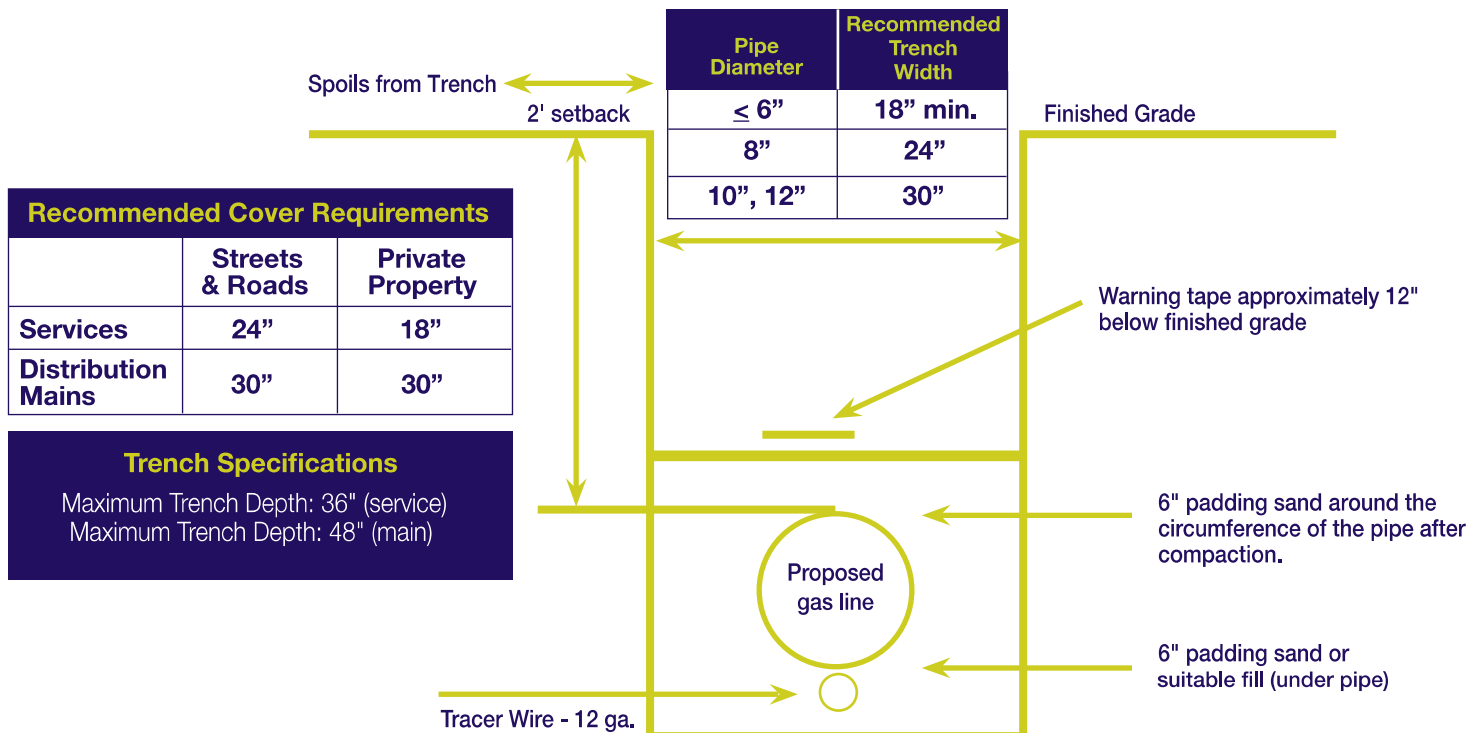
- Prior to beginning any outdoor construction that involves digging, excavating, trenching or grading, remember to call **811** or Dig Safe at **888-DIG-SAFE** (888-344-7233). State laws require advance notice of at least 48 to 72 hours (excluding weekends and holidays) before you get ready to begin your outdoor project.
- Coordinate installation schedule with National Grid.
- Any excavation within 18 inches of existing mains and/or services shall be hand dug. Expose existing gas service stub or main (where applicable) and fully excavate trench in accordance with trench specifications below.
- Provide and place a minimum of 6 inches of padding sand or suitable fill (subject to gas company approval) in the bottom of trench prior to gas company arrival.
- Provide and place sufficient padding sand around the gas line along the entire length of the trench to provide 6 inches of padding.
- Backfill balance of entire trench with suitable fill when National Grid work crews are on site.

National Grid Obligations

- Inspect for trench specification compliance.
- Provide pipe and related materials including fittings, tracer wire and warning tape.

Trench Specifications

- Bottom of trench must be smooth, as level as practical and free of rocks and other abrasives.
- Padding sand and suitable fill (subject to approval by National Grid) should be free of stones or other abrasive material.
- Gas service must have a minimum separation of 3 feet from parallel utilities.
- Maintain a minimum of 1 foot separation when crossing other utilities (subject to approval by National Grid).



Contact Information Business Name: _____ Premise Address: _____ City, State, Zip: _____ Business Phone: _____ Fax Number: _____ Mailing/Billing: _____ City, State, Zip: _____ Contact Name: _____ Contact Phone: _____ Contact Email: _____ Contractor Name: _____ Contractor Phone: _____ Contractor Email: _____		CHECK ALL THAT APPLY Surrounding Area Description: <input type="checkbox"/> Wetlands/Water <input type="checkbox"/> Historic <input type="checkbox"/> Nature Preserve <input type="checkbox"/> Undeveloped <input type="checkbox"/> Urban <input type="checkbox"/> N/A Site Information: (on private property along service route) <input type="checkbox"/> Sprinkler <input type="checkbox"/> Septic <input type="checkbox"/> Trees <input type="checkbox"/> Ledge/Rock <input type="checkbox"/> Side Walk <input type="checkbox"/> Drive Way <input type="checkbox"/> Parking Lot Underground Utilities: <input type="checkbox"/> Electric <input type="checkbox"/> Phone <input type="checkbox"/> Cable <input type="checkbox"/> Underground Oil Tank Customer Installation Expectations: Planned Natural Gas Equipment Installation Date: _____ Requested Service-Main Installation Date: _____ Estimated Meter Turn on Date: _____
---	--	---

This agreement is subject to the **Terms and Conditions on the back of this agreement**. The Narragansett Electric Company d/b/a National Grid (National Grid) agrees to install a gas service to the above location (Premises). I understand that I may cancel this agreement, without obligation, at anytime prior to the installation of the gas service line. I hereby authorize National Grid to install a natural gas service line to the address noted above.

PAYMENT INFORMATION: Please do not send payment along with this contract. An invoice will be generated upon receipt of this application with the option to pay by check. Please note: all invoices must be paid within sixty days.

Customer Contribution Towards Construction Cost:* \$ _____ **Customer to dig & provide backfill (EBBO) Yes** ☐ **No** ☐

*Customer quote is valid for 90 days from the date of the "National Grid Rep Signature" below. After 90 days, this amount is no longer valid and is subject to change.

Owner/Applicant Signature: _____ **Date:** _____

National Grid Rep Signature: _____ **Date:** _____

National Grid Use Only: Public Bldg: Yes <input type="checkbox"/> No <input type="checkbox"/>								Sales Type:		Sales Type:		Work Required:																																																																	
Trench Paving: Yes <input type="checkbox"/> No <input type="checkbox"/> Estimated Length _____								<input type="checkbox"/> New Construction		<input type="checkbox"/> Conversion		<input type="checkbox"/> Add Meter																																																																	
Number of Services: _____ Average Service Length _____								<input type="checkbox"/> Rehab		<input type="checkbox"/> Low Use		<input type="checkbox"/> Fitting Work																																																																	
Total Estimated Length: Service _____ Main _____								<input type="checkbox"/> Added Load		<input type="checkbox"/> Oil		<input type="checkbox"/> Main/Svc																																																																	
Intersecting Street: _____								<input type="checkbox"/> Off-1-Year		<input type="checkbox"/> Propane		<input type="checkbox"/> New Svc																																																																	
<table><tr><th>Suite or Unit #</th><th>Rate</th><th>CFH</th><th>ADTH</th><th>Meter Size</th><th>Delivery Pressure</th><th>Margin</th><th>MADQ</th></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td colspan="2">TOTAL</td><td> </td><td colspan="3"> </td><td> </td><td> </td></tr></table>								Suite or Unit #	Rate	CFH	ADTH	Meter Size	Delivery Pressure	Margin	MADQ																																																	TOTAL								<input type="checkbox"/> Rate Change		<input type="checkbox"/> Electricity		<input type="checkbox"/> Relay Svc	
Suite or Unit #	Rate	CFH	ADTH	Meter Size	Delivery Pressure	Margin	MADQ																																																																						
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Target Date: _____ Account Location: _____								Multifamily: _____ #Apts. _____		Activity Request:																																																																			
Work Order: Service _____ Main _____								<input type="checkbox"/> Bldg. Mtr.		<input type="checkbox"/> Heat		<input type="checkbox"/> Eng Analysis																																																																	
Easement Required: Yes <input type="checkbox"/> No <input type="checkbox"/>								<input type="checkbox"/> House Mtr.		<input type="checkbox"/> Hot Water		<input type="checkbox"/> Construction Est.																																																																	
Permits: <input type="checkbox"/> Town <input type="checkbox"/> State <input type="checkbox"/> Conservation <input type="checkbox"/> Private Way								<input type="checkbox"/> Individual Mtr.		<input type="checkbox"/> Cooking		<input type="checkbox"/> Sold																																																																	
Existing Service Information (if applicable)								<input type="checkbox"/> Master Mtr.		<input type="checkbox"/> Drying		<input type="checkbox"/> Project Managed																																																																	
Acct. #: _____ / _____ Rate: _____								_____ LP _____ IP _____ HP		Pre-Marked: _____																																																																			
CFH: _____ Service Size: _____ Meter Size: _____																																																																													
Notes: 1) Gas Letter - Reference "Exhibit A" attached 2) Reference site drawing schematic for proposed service installation route. "Exhibit B"																																																																													

Terms and Conditions of Commercial Gas Service Agreement

1. Applicant agrees to pay National Grid to aid in the construction of the natural gas service line and associated main work required to provide service to the Premises. In the event that the actual service line length exceeds the estimated footage, National Grid may bill the property owner at a rate of (Excess Footage Fee) over the estimated service line length.
2. Once the meter is set, the Applicant becomes the customer of record and National Grid will commence billing the Applicant. The Applicant agrees to pay for gas service pursuant to the applicable rate classification and in accordance with National Grid's Terms and Conditions, as filed from time to time with the Rhode Island Public Utilities Commission.
3. National Grid will take reasonable measures to minimize damage to Applicant's property. For existing structures, National Grid will loam and reseed excavated areas and patch disturbed asphalt. Applicant is responsible for maintaining all reseeded areas.
4. National Grid will install the necessary natural gas distribution system to the site, subject to weather conditions and all federal, state and local codes and permit requirements. In the event that National Grid is unable to obtain the necessary permits to install the gas service line, National Grid shall not be obligated to perform such installation and this Agreement shall be null and void.
5. Notwithstanding the foregoing, National Grid may, at any time, terminate this Agreement without any further obligations, in the event of one of the following "Triggering Conditions": (a) it discovers that there is no active natural gas main in close proximity to Applicant's property for which a service connection can be made in a reasonably cost effective manner (b) it discovers conditions (including, without limitation, ledge, steep grades, and retaining walls), that would, in National Grid's judgment, materially increase the cost of installation, or (c) the fees for the required permits are significantly in excess of what is typical for such work (d) National Grid is unable to obtain the necessary permits to install the gas service line. In the event of a Triggering Condition, National Grid shall consider any Applicant proposals for an adjustment of price.
6. National Grid will not be responsible for delays or damages associated with the installation of a gas service line due to weather or the issuance of permits, nor will it be responsible for damages attributable to unforeseen conditions beyond its control.
7. National Grid's obligation under this Agreement are subject to verification that there is an active natural gas main in close proximity to the Applicant's property for which a service connection can be made in a reasonably cost effective manner.
8. (New Construction Only) Applicant shall construct, or cause the construction of all necessary water lines, sewer lines, roads and electrical lines, and will perform other necessary work required to prepare the site for the installation.
9. Applicant shall provide all easements and rights-of-way necessary for National Grid to install natural gas distribution lines required to provide service to the Premises.
10. National Grid will accept or modify the meter location shown on the front of this form based upon its installation requirements.
11. Applicant assumes full and complete responsibility for any and all costs associated with any environmental contamination encountered by National Grid during the installation, including but not limited to the costs to clean up or remediate such contamination.
12. In the event that environmental contamination is encountered during the installation, all work shall cease and National Grid shall provide oral and written notice to the Applicant within a reasonable time. Thereafter, National Grid shall have no further obligations under this agreement.
13. Applicant shall, to the fullest extent permitted by law, indemnify, hold harmless and release National Grid, its parent company, affiliates and subsidiaries and their respective directors, officers, employees, agents, servants, representatives, successors and assigns from and against all claims, demands, liabilities or expenses related to environmental contamination at or in the vicinity of the Premises. This indemnity and release provision survives the expiration or termination of the Agreement and extends to the respective successors and assigns of National Grid and Applicant.
14. National Grid shall own the natural gas distribution system up to the outlet side of each individual customer meter.
15. All installations where excavating and back filling are to be performed by Applicant or his/her designee will be performed in compliance with National Grid's specifications, and the installation shall not commence until said trench is inspected and accepted by a representative of National Grid.
16. In the event that the gas equipment identified on the front of this agreement is not installed and in use within six months of the date of installation of the service line, the Applicant agrees to pay National Grid for the cost of installing all gas lines necessary to serve Premises, minus any prior contribution in aid of construction made to National Grid.
17. Prior to the start of the work described on the front of this agreement, Applicant is responsible for marking out any underground facilities on their property that are not marked out as a result of National Grid's notification of the Dig Safe system.
17. This Agreement may be modified only by a writing signed by National Grid and Applicant; any verbal representations or modifications by National Grid employees or others shall be null and void.
18. The laws of the State of Rhode Island shall govern this Agreement.
19. If Applicant changes the primary fuel from natural gas to an alternate fuel source during the first five (5) years after billing commences, National Grid reserves the right to reevaluate the financial impact of this change and bill Applicant for a portion of its original investment.
20. If any terms of this Agreement or portions thereof are declared or become invalid or unenforceable, the remainder of this Agreement shall continue in full force and effect.



SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

11/20, CHG 1: 02/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EP 1110-1-8 (2016) Construction Equipment Ownership
and Operating Expense Schedule

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Earned Value Report; G

1.3 EARNED VALUE REPORT

1.3.1 Data Required

This Contract requires the use of a cost-loaded Network Analysis Schedule (NAS). Schedule of Prices must not be used with cost-loaded Network Analysis Schedule (NAS). Use Earned Value Report derived from cost-loaded NAS. Provide a detailed breakdown of the Contract price, giving quantities for each of the various kinds of work, unit prices and extended prices. Contractor overhead and profit including salaries for field office personnel, if applicable, must be proportionately spread over all pay items and not included as individual pay items.

1.3.2 Payment Schedule Instructions

Payments will not be made until the Earned Value Report from the cost-loaded NAS has been submitted to and accepted by the Contracting Officer. For design phase progress payment(s), the Schedule of Prices or Earned Value Report from the Cost Loaded CPM must include detailed design activities and general (summarized) approach for the construction phase(s) of the project.

1.3.3 Schedule Requirements for HVAC TAB

The field work requirements in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC must be broken down in the Earned Value Report from the cost-loaded NAS by separate line items which reflect measurable deliverables. The value for each pay item listed below will be established on a case by case basis for each Contract. The line items are

as follows:

- a. Approval of Design Review Report: The TABS Agency is required to conduct a review of the project plans and specifications to identify any feature, or the lack thereof, that would preclude successful testing and balancing of the project HVAC systems. Submit the resulting findings to the Government to allow correction of the design. The progress payment will not be issued until the report is reviewed and approved.
- b. Approval of the pre-field engineering report: The TABS Agency submits a report which outlines the scope of field work. The report must contain details of what systems will be tested, procedures to be used, sample report forms for reporting test results and a quality control checklist of work items that must be completed before TABS field work commences.
- c. Season I field work: Incremental payments are issued as the TABS field work progresses. The TABS Agency mobilizes to the project site and executes the field work as outlined in the pre-field engineering report. The HVAC water and air systems are balanced and operational data must be collected for one seasonal condition (either summer or winter depending on project timing).
- d. Approval of Season I report: On completion of the Season I field work, the data is compiled into a report and submitted to the Government. The report is reviewed, and approved, after ensuring compliance with the pre-field engineering report scope of work.
- e. Completion of Season I field QA check: Contract QC and Government representatives meet the TABS Agency at the jobsite to retest portions of the systems reported in the Season I report. The purpose of these tests are to validate the accuracy and completeness of the previously submitted Season I report.
- f. Approval of Season II report: The TABS Agency completes all Season II field work, which is normally comprised mainly of taking heat transfer temperature readings, in the season opposite of that under which Season I performance data was compiled. Compile this data into a report and submit to the Government. On completion of submittal review to ensure compliance with the pre-field engineering report scope, progress payment is issued. Progress payment is less than that issued for the Season I report since most of the water and air balancing work effort is completed under Season I.

1.4 CONTRACT MODIFICATIONS

In conjunction with the Contract Clause DFARS 252.236-7000 Modification Proposals-Price Breakdown, and where actual ownership and operating costs of construction equipment cannot be determined from Contractor accounting records, base equipment use rates upon the applicable provisions of the EP 1110-1-8.

1.5 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.5.1 Content of Invoice

Requests for payment will be processed in accordance with the Contract Clause FAR 52.232-27 Prompt Payment for Construction Contracts and FAR

52.232-5 Payments Under Fixed-Price Construction Contracts. Invoices not completed in accordance with contract requirements will be returned to the Contractor for correction of the deficiencies. The requests for payment shall include the documents listed below.

- a. The Contractor's invoice, on NAVFAC Form 7300/30 furnished by the Government, showing in summary form, the basis for arriving at the amount of the invoice. Form 7300/30 must include certification by Quality Control (QC) Manager as required by the Contract.
- b. The Earned Value Report from the cost-loaded NAS.
- c. Contractor's Monthly Estimate for Voucher and Contractors Certification (NAVFAC Form 4330) with Subcontractor and supplier payment certification. Other documents, including but not limited to, that need to be received prior to processing payment include the following submittals as required. These items are still required monthly even when a pay voucher is not submitted.
- d. Monthly Work-hour report.
- e. Updated Construction Progress Schedule and tabular reports required by the contract.
- f. Contractor Safety Self Evaluation Checklist.
- g. Updated submittal register.
- h. Solid Waste Disposal Report.
- i. Certified payrolls.
- j. Updated testing logs.
- k. Other supporting documents as requested.

1.5.2 Submission of Invoices

If DFARS Clause 252.232-7006 Wide Area WorkFlow Payment Instructions is included in the Contract, provide the documents listed in above paragraph CONTENT OF INVOICE in their entirety as attachments in Wide Area Work Flow (WAWF) for each invoice submitted. The maximum size of each WAWF attachment is two megabytes, but there are no limits on the number of attachments. If a document cannot be attached in WAWF due to system or size restriction, provide it as instructed by the Contracting Officer.

Monthly invoices and supporting forms for work performed through the anniversary award date of the Contract must be submitted to the Contracting Officer within 5 calendar days of the date of invoice. For example, if Contract award date is the 7th of the month, the date of each monthly invoice must be the 7th and the invoice must be submitted by the 12th of the month.

1.5.3 Final Invoice

- a. A final invoice must be accompanied by the certification required by DFARS 252.247.7023 Transportation of Supplies by Sea, and the Contractor's Final Release. If the Contractor is incorporated, the Final Release must contain the corporate seal. An officer of the

corporation must sign and the corporate secretary must certify the Final Release.

- b. For final invoices being submitted via WAWF, the original Contractor's Final Release Form and required certification of Transportation of Supplies by Sea must be provided directly to the respective Contracting Officer prior to submission of the final invoice. Once receipt of the original Final Release Form and required certification of Transportation of Supplies by Sea has been confirmed by the Contracting Officer, the Contractor must then submit final invoice and attach a copy of the Final Release Form and required certification of Transportation of Supplies by Sea in WAWF.
- c. Final invoices not accompanied by the Contractor's Final Release and required certification of Transportation of Supplies by Sea will be considered incomplete and will be returned to the Contractor.

1.6 PAYMENTS TO THE CONTRACTOR

Payments will be made on submission of itemized requests by the Contractor which comply with the requirements of this section, and will be subject to reduction for overpayments or increase for underpayments made on previous payments to the Contractor.

1.6.1 Obligation of Government Payments

The obligation of the Government to make payments required under the provisions of this Contract will, at the discretion of the Contracting Officer, be subject to reductions and suspensions permitted under the FAR and agency regulations including the following in accordance with FAR FAR 32.103 Progress Payments Under Construction Contracts:

- a. Reasonable deductions due to defects in material or workmanship;
- b. Claims which the Government may have against the Contractor under or in connection with this Contract;
- c. Unless otherwise adjusted, repayment to the Government upon demand for overpayments made to the Contractor; and
- d. Failure to maintain accurate "as-built" or record drawings in accordance with FAR 52.236.21.

1.6.2 Payment for Onsite and Offsite Materials

Progress payments may be made to the Contractor for materials delivered on the site, for materials stored off construction sites, or materials that are in transit to the construction sites under the following conditions:

- a. FAR 52.232-5(b) Payments Under Fixed Price Construction Contracts.
- b. Materials delivered on the site but not installed, including completed preparatory work, and off-site materials to be considered for progress payment must be major high cost, long lead, special order, or specialty items, not susceptible to deterioration or physical damage in storage or in transit to the construction site. Examples of materials acceptable for payment consideration include, but are not limited to, structural steel, non-magnetic steel, non-magnetic aggregate, equipment, machinery, large pipe and fittings,

precast/prestressed concrete products, plastic lumber (e.g., fender piles/curbs), and high-voltage electrical cable. Materials not acceptable for payment include consumable materials such as nails, fasteners, conduits, gypsum board, glass, insulation, and wall coverings.

- c. Materials to be considered for progress payment prior to installation must be specifically and separately identified in the Contractor's estimates of work submitted for the Contracting Officer's approval in accordance with Earned Value Report requirement of this Contract. Requests for progress payment consideration for such items must be supported by documents establishing their value and that the title requirements of the clause at FAR 52.232-5 Payments Under Fixed-Price Construction Contracts have been met.
- d. Materials are adequately insured and protected from theft and exposure.
- e. Provide a written consent from the surety company with each payment request for offsite materials.
- f. Materials to be considered for progress payments prior to installation must be stored either in Hawaii, Guam, Puerto Rico, or the Continental United States. Other locations are subject to written approval by the Contracting Officer.
- g. Materials in transit to the job site or storage site are not acceptable for payment.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

11/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety -- Safety and Health
Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

View Location Map

Progress and Completion Pictures

1.3 VIEW LOCATION MAP

Submit, prior to or with the first digital photograph submittals, a sketch or drawing indicating the required photographic locations. Update as required if the locations are moved.

1.4 PROGRESS AND COMPLETION PICTURES

Photographically document site conditions prior to start of construction operations. Include aerial photographs. Provide monthly, and within one month of the completion of work, digital photographs, 1600x1200x24 bit true color minimum resolution in JPEG file format showing the sequence and progress of work. Take a minimum of 20 digital photographs each week throughout the entire project from a minimum of ten different viewpoints selected by the Contractor unless otherwise directed by the Contracting Officer. Submit with the monthly invoice two sets of digital photographs, each set on a separate compact disc (CD) or data versatile disc (DVD), cumulative of all photos to date. Indicate photographs demonstrating environmental procedures. Provide photographs for each month in a separate monthly directory and name each file to indicate its location on the view location sketch. Also provide the view location sketch on the CD or DVD as a digital file. Include a date designator in file names. Photographs provided are for unrestricted use by the Government.

1.5 MINIMUM INSURANCE REQUIREMENTS

Provide the minimum insurance coverage required by FAR 28.307-2 Liability,

during the entire period of performance under this contract. Provide other insurance coverage as required by State law.

1.6 SUPERVISION

1.6.1 Superintendent Qualifications

Provide project superintendent with a minimum of 10 years experience in construction with at least 5 of those years as a superintendent on projects similar in size and complexity. The individual must be familiar with the requirements of EM 385-1-1 and have experience in the areas of hazard identification and safety compliance. The individual must be capable of interpreting a critical path schedule and construction drawings. The qualification requirements for the alternate superintendent are the same as for the project superintendent. The Contracting Officer may request proof of the superintendent's qualifications at any point in the project if the performance of the superintendent is in question.

1.6.2 Minimum Communication Requirements

Have at least one qualified superintendent, or competent alternate, capable of reading, writing, and conversing fluently in the English language, on the job-site at all times during the performance of Contract work. In addition, if a Quality Control (QC) representative is required on the Contract, then that individual must also have fluent English communication skills.

1.6.3 Duties

The project superintendent is primarily responsible for managing subcontractors and coordinating day-to-day production and schedule adherence on the project. The superintendent is required to attend Red Zone meetings, partnering meetings, and quality control meetings. The superintendent or qualified alternative must be on-site at all times during the performance of this contract until the work is completed and accepted.

1.6.4 Non-Compliance Actions

The Project Superintendent is subject to removal by the Contracting Officer for non-compliance with requirements specified in the contract and for failure to manage the project to ensure timely completion. Furthermore, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders is acceptable as the subject of claim for extension of time for excess costs or damages by the Contractor.

1.7 PRECONSTRUCTION MEETING

Immediately after award, prior to commencing any work at the site, coordinate with the Contracting Officer a time and place to meet for the Preconstruction Meeting. The meeting must take place within 35 calendar days after award of the contract, but prior to commencement of any work at the site. The purpose of this meeting is to discuss and develop a mutual understanding of the administrative requirements of the Contract including but not limited to: daily reporting, invoicing, value engineering, safety, base-access, outage requests, hot work permits, schedule requirements, quality control, schedule of prices or earned value report, shop drawings,

submittals, cybersecurity, prosecution of the work, government acceptance, final inspections and contract close-out. Contractor must present and discuss their basic approach to scheduling the construction work and any required phasing.

1.7.1 Attendees

Contractor attendees must include the Project Manager, Superintendent, Site Safety and Health Officer (SSHO), Quality Control Manager and major subcontractors.

1.8 FACILITY TURNOVER PLANNING MEETINGS (Red Zone Meetings)

Meet with the Government to identify strategies to ensure the project is carried to expeditious closure and turnover to the Client. Start planning the turnover process at the Pre-Construction Conference meeting with a discussion of the Red Zone process and convene at regularly scheduled NRZ Meetings beginning at approximately 75 percent of project completion. Include the following in the facility Turnover effort:

1.8.1 Red Zone Checklist

- a. Contracting Officer's Technical Representative (COTR) will provide the Contractor a copy of the Red Zone Checklist template.
- b. Prior to 75 percent completion, modify the Red Zone Checklist template by adding or deleting critical activities applicable to the project and assign planned completion dates for each activity. Submit the modified Red Zone Checklist to the Contracting Officer. The Contracting Officer may request additional activities be added to the Red Zone Checklist at any time as necessary.

1.8.2 Meetings

- a. Conduct regular Red Zone Meetings beginning at approximately 75 percent project completion, or three to six months prior to Beneficial Occupancy Date (BOD), whichever comes first.
- b. The Contracting Officer will establish the frequency of the meetings, which is expected to increase as the project completion draws nearer. At the beginning, Red Zone meetings may be every two weeks then increase to weekly towards the final month of the project.
- c. Using the Red Zone Checklist as a Plan of Action and Milestones (POAM) and basis for discussion, review upcoming critical activities and strategies to ensure work is completed on time.
- d. During the Red Zone Meetings discuss with the COTR any upcoming activities that require Government involvement.
- e. Maintain the Red Zone Checklist by documenting the actual completion dates as work is completed and update the Red Zone Checklist with revised planned completion dates as necessary to match progress. Distribute copies of the current Red Zone Checklist to attendees at each Red Zone Meeting.

1.9 PARTNERING

To most effectively accomplish this Contract, the Contractor and

Government must form a cohesive partnership with the common goal of drawing on the strength of each organization in an effort to achieve a successful project without safety mishaps, conforming to the Contract, within budget and on schedule. The partnering team must consist of personnel from both the Government and Contractor including project level and corporate level leadership positions. Key Personnel from the supported command, end user, NAVFAC, PWD, FEAD/ROICC, Contractor, key subcontractors and the Designer of Record are required to participate in the Partnering process.

1.9.1 Facilitated (Formal) Partnering

- a. Within 35 calendar days after award and prior to the start of work, host a Formal Partnering session with key personnel from the project team including both Contractor and Government personnel. All costs associated with the Partnering session including the third-party independent Facilitator Consultant, meeting room and other incidental items are the responsibility of the Contractor.
- b. Before the Facilitated (Formal) Partnering session, coordinate with the Facilitator all requirements for incidental items (such as audio-visual equipment, easels, flipchart paper, colored markers, note pads, pens/pencils, colored flash cards) and have these items available at the Partnering session. Provide copies of any documents required for distribution to all attendees. Participants will bear their own costs for meals, lodging and transportation associated with Partnering.
- c. The Initial Partnering Session must be a duration of one day and be held at a location off base as agreed to by the Contracting Officer. Partnering session may take place concurrently with the Pre-Construction Meeting.
- d. Facilitator must be experienced in conducting corporate Partnering sessions and must be a third-party independent facilitating consultant - not an employee of the Contractor. The Facilitator is responsible for leading all aspects of the Partnering session necessary to achieve the Partnering goal.
- e. An outcome of the Partnering session must be an escalation matrix agreed upon by both the Government and Contractor, which identifies key Government and Contractor decision makers by name and anticipated decision durations.
- f. Host follow-on Partnering Sessions at three- to six-month intervals or more frequently if needed and lasting generally a half day or less. Attendees need only be those required to resolve current issues. The same Facilitator used in the Initial Partnering session must lead the follow-on sessions unless an alternative is permitted by the Contractor Officer. All costs associated with follow-on Partnering sessions are the responsibility of the Contractor.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SECTION 01 30 01.00 22

DESIGN, PROCUREMENT AND INSTALLATION OF FURNITURE, FIXTURES AND EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

UNIFIED FACILITIES CRITERIA (UFC)

UFC 03-120-10

Interior Design

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following must be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Contractor's Interior Designer's Qualifications; G, ID

FF&E Schedule and Schedule Updates; G, ID

FF&E Concept Presentation Submittal / Over The Shoulder Review; G, ID

Best Value Determination Pricing Solicitation / Over The Shoulder Review; G, ID

Best Value Determination Recommendation FF&E; G, ID

Best Value Determination Recommendation A/V; G, EE

Preliminary (Pre-Final) FF&E Package; G, ID

Final FF&E Package; G, ID

Audio Visual Package; G, EE

1.3 GENERAL REQUIREMENTS

Furnishings, Fixtures, and Equipment (FF&E) includes, but is not limited to items such as; systems and modular furniture, desks, workstations, seating, storage, filing, visual display items, accessories, artwork, training and conference furniture, soft window treatments, shop equipment, dorm and quarters furnishings and other miscellaneous items, to support facility functions. Weapon racks, drying cages, and lockers are not typically considered FF&E. FF&E and A/V must be fully integrated with the

building systems and finishes. FF&E may also include specialty items for which the customer activity will be responsible for specifying.

The design and documentation of the FF&E and A/V must be funded as Interior Design Services and included in the Base Bid. The purchase and installation of the FF&E Package and A/V Package must be funded separately as the FF&E and A/V Planned Modifications. The Government FF&E and A/V estimates on the price schedule to OFFERORS (Bid Schedule/Price Proposal Form) for the FF&E and A/V Planned Modifications does NOT include the Contractor's Handling and Administration Rate (HAR). This Government FF&E and A/V estimate must not be altered by Contractors during the bid process.

All FF&E items are subject to the Buy American Act or Trade Agreement Act, unless they are considered COTS (Consumer Off The Shelf) items per the FAR.

1.4 INTERIOR DESIGN SERVICES

1.4.1 Interior Designer Qualifications and Affiliations

Per UFC 03-120-10, The Prime Contractor must provide the services of an Interior Designer with the following qualifications. The Prime Contractor's Interior Designer, must be certified by the National Council for Interior Design Qualification (NCIDQ), must have attained certification, registration or licensure and must have experience as the primary interior designer on projects of similar type, size, scope and complexity. Experience writing non-proprietary, technical performance criteria for competitive furniture bids and experience analyzing competitive furniture bid proposals, is required and must be clearly indicated in resume. The Prime Contractor's Interior Designer, Design Firm owners, and any Specialists must NOT have any affiliation or partnership with any furniture, fixture, or equipment products, any furniture dealership or manufacturers. Additionally, the Prime Contractor is required to use the services of an Interior Designer other than the A/E's Interior Designer who developed the Concept FF&E Package. Provide a detailed resume, client references and documentation of the Prime Contractor's Interior Designer's qualifications and significant interior design experience to the NAVFAC Interior Designer PRIOR to the Kick-off/Partnering Meeting. The Government will approve/disapprove the Prime Contractor's Interior Designer based on the provided documentation and past performance.

1.4.2 Concept FF&E package

A basic concept FF&E package, prepared by the A/E's Interior Designer, indicating the salient characteristics of all required FF&E items, will be provided to the Prime Contractor. The Prime Contractor's Interior Designer must further develop and revise this concept package, as required, to prepare/provide a final, best valued FF&E package, in accordance with the requirements in this document. The Prime Contractor must provide the Contractor's Interior Designer a complete set of the construction drawings (CAD files) prior to commencement of work on the project.

1.4.3 FF&E Schedule

For all projects, including fast track projects and renovations, the Prime Contractor is responsible for sufficiently scheduling all FF&E meetings and deliverables early enough to:

- a. Obtain the required government approvals
- b. Meet all FF&E ordering and installation lead times
- c. Complete the FF&E installation by the contract completion date

All submittal due dates for the FF&E must be noted in the FF&E Schedule and reflected in the Prime Contractor's construction schedule. A proposed FF&E schedule for all FF&E Services and Deliverables must be provided to the Construction Manager, NAVFAC Interior Designer and Contracting Officer seven business days after the Interior Design Orientation Meeting. An FF&E Schedule Guideline template is available from the NAVFAC Interior Designer, for your use in developing a schedule. Schedule updates must be submitted as the construction schedule is revised. The Final FF&E package must be submitted no later than 6 months prior to the funding deadline (to be determined by funding source) and approved no later than nine months prior to the Contract Completion Date.

1.4.4 FF&E and CEQ (Collateral Equipment) Services

The Contractor's Interior Designer and Equipment Specialists are responsible for developing equipment packages for FF&E and other specialty equipment, i.e. shop equipment, kitchen equipment, fitness equipment, laboratory equipment, medical equipment, weapons racks, high-density storage, etc., required in the project. The Contractor must obtain the services of equipment specialists to provide design services and assist the Interior Designer with the development of non-proprietary performance criteria for the specialty equipment. Specialty equipment may require coordination with the Prime Contractor and subcontractors for connection of power, data, communications, waterlines, gases, calibration, testing, etc. prior to facility turnover and operation. The Equipment Specialist(s) must provide coordination of all necessary steps to provide a completely functional and operational facility at building turnover.

The Prime Contractor's Interior Designer and Equipment Specialist(s) are required to meet with the Activity to discuss the function of each area, validate all FF&E, CEQ and specialty equipment requirements, make any necessary changes and additions to the Concept FF&E package and recommend any adjustments/revisions to the interior building finishes and building infrastructure. The FF&E/CEQ effort includes the design, selection, specification, color coordination, procurement documentation and installation coordination of the equipment items necessary to meet the functional, operational, sustainability, and aesthetic needs of the facility. The FF&E/CEQ packages must be fully integrated with the design, construction, and schedule of all building finishes and all building systems (HVAC, Plumbing, Fire Protection, Communications, Electrical, Data, Architecture, etc.)

All electrical, data and communications outlets, switches, fire extinguishers, thermostats, sprinkler heads, etc. must be accommodated and/or relocated so that they are fully accessible once FF&E, CEQ and specialty equipment is installed. ABA clearances must be accommodated. The Contractor's Interior Designer must work with the Prime Contractor and the electrical and telecommunication subcontractors to coordinate all infrastructure with the Recommended vendors. Dimensioned locations on plans and elevations for Multi-user Telecommunications Outlet Assemblies (MUTOAs), junction boxes, wall outlets and floor boxes, must be determined and provided by Contractor's Interior Designer, based on the sizes, layouts and configurations of the equipment items to be provided. See Section 1.5.8 Subsection h. If infrastructure planned for the building, such as power/data/communications requirements, must be revised to support

the FF&E package, those revisions and coordination are the responsibility of the Contractor's Interior Designer and the Prime Contractor.

The FF&E plans must take into consideration any/all Collateral Equipment (CEQ) to include specialty equipment, existing and future Government-Furnished, Government Installed (GFGI) equipment and Government-Furnished, Contractor-Installed Equipment (GFCI). These items may include, but are not limited to: multi-function devices, printers, shredders, safes, vending machines, etc.

- a. The Contractor's Interior Designer is responsible for creating an inventory of existing CEQ equipment to be relocated to the new facility and incorporating new and existing CEQ into the FF&E plans.

These are minimum requirements and the Prime Contractor must be prepared to provide any/all additional meetings and submittals that may be necessary to support the Interior Design effort and FF&E coordination.

The Contractor's Interior Designer and equipment specialists are responsible for developing competitive and biddable Request for Proposal packages, with comprehensive, non-proprietary, technical performance criteria, as directed by the NAVFAC Interior Designer. Equipment must be biddable by at least three providers and the technical performance criteria must be based on product that is available through GSA schedules, and other Federal contracts, in compliance with priorities found in FAR Part 8.404, when possible. If GSA vendors do not have access to the required equipment, research to find appropriate specialty equipment vendors may be required. Utilization of NAVFAC-provided templates is required for all Best Value Determination efforts and deliverables. The utilization of the current GSA Multiple Awards Schedules (MAS) Packaged Office Furniture SIN 33721P is required for BVD Analysis Request for Pricing.

NAVFAC MIDLANT specific templates will be provided by the NAVFAC Interior Designer.

1.4.5 Audio Visual (A/V) Services

When A/V equipment is required, a Certified Technology Specialist-Design (CTS-D) whose certification is ANSI accredited is required for the design and preparation of A/V packages. The Equipment Specialist(s) must provide separate Best Value Determinations (BVDs) for all categories of specialty equipment, if required by NAVFAC. If GSA vendors do not have access to the required equipment, research to find appropriate specialty equipment vendors may be required. The final equipment packages must be in accordance with the general interior design requirements in UFC 03-120-10, and as required for all areas as determined during the client FF&E and A/V programming.

The A/V package must be prepared by the Contractor's ID and A/V Certified Technology Specialist-Design (CTS-D) as a separate package. If an A/V or specialty equipment package is required, the design, procurement, and installation of the package must comply with all of the same requirements as those defined for the FF&E package in this specification section. Additionally, A/V floor plans and elevations must be provided, indicating equipment locations and A/V riser diagrams for all A/V systems, and to coordinate equipment locations and power requirements with power plans and FF&E locations. The A/V and specialty packages must be fully integrated into the design, construction, and schedule of all building finishes and all building systems (HVAC, Plumbing, Fire Protection, Communications,

Electrical, Data, Architecture, etc.) All outlets, switches, thermostats, fire extinguishers, etc. must be fully accessible once all equipment is installed. All sprinkler heads, fire extinguishers, ABA clearances, etc. must be accommodated.

1.5 FF&E MEETINGS, PRESENTATIONS AND SUBMITTALS

The Prime Contractor's Interior Designer and the NAVFAC Interior Designer must attend all meetings, site visits and walk-throughs, as well as coordinate FF&E mock-ups, as required, obtain end-user and NAVFAC approvals and provide a complete and functional FF&E package. All meetings must be coordinated with advance notice to the NAVFAC Interior Designer, so that schedule and travel can be coordinated.

Each submittal must demonstrate thorough interaction with the Activity's functional requirements and complete coordination with the facility design and the Structural Interior Design (SID).

1.5.1 Interior Design Orientation Meeting

This meeting must occur via conference call within 7 days of Pre-Construction/Kick-Off meeting, unless Contractor's Interior Designer approval is pending. If this meeting occurs at the Kick-Off Meeting, it must include a walk-through of the Activity's existing facility(s) or similar facilities. The NAVFAC Interior Designer will review the following with the Prime Contractor and the Contractor's Interior Designer: Schedule Development, Concept FF&E package, Best Value Determination (BVD) NAVFAC templates and process, Number of Best Value Determinations required, and GSA or other mandatory sources to consider. A proposed preliminary schedule for the FF&E Meetings and Submittals must be submitted to the NAVFAC Interior Designer within 7 business days of this meeting. A final decision on the number of Best Value Determinations required may be dependent on the Prime Contractor's construction schedule and phasing.

1.5.2 FF&E Concept Presentation Submittal and "Over the Shoulder" Review

Prior to the FF&E Concept Presentation to the Activity/End User, the Contractor's Interior Designer must present the FF&E Concept to the NAVFAC Interior Designer. If the Contractor's Interior Designer is remotely located, they can submit one hard copy of the presentation to the NAVFAC Interior Designer and schedule a follow-up discussion to review the presentation. If the Contractor's Interior Designer is local to the Norfolk, VA area, a meeting is required. The submittal can be presented in a "loose" format or binder (no presentation boards required) for NAVFAC approval prior to the Activity presentation. Catalog cut sheets and visuals from various manufacturers for each major FF&E item must be provided, along with cut sheets depicting commonly available options. Cut sheets should be clearly labeled with the item numbers used in the Concept FF&E package and FF&E plans. Information on durability and availability of finishes should be readily available for discussion. Fabric and finishes should not be discussed, except in terms of durability. The "over-the-shoulder" review meeting will be held via conference call.

1.5.3 FF&E Concept Presentation to the Activity

After implementing all feedback from the NAVFAC FF&E Concept Presentation, the Prime Contractor's Interior Designer must present the NAVFAC approved Preliminary (Pre-final) FF&E package to the Activity, located at Naval Station Newport, Newport, Rhode Island, for feedback and approval. This

meeting must include a walk-through of the Activity's existing facility(s) or similar facilities, if this was not a part of the Kick-Off meeting. During this meeting, a detailed, functional review of the entire project must occur, with the proposed FF&E presentation to follow, to ensure that all current FF&E requirements have been captured. The presentation must include catalog cut sheets and visuals from various manufacturers for each major FF&E item, along with cut sheets depicting commonly available options. Cut sheets should be clearly labeled with the item numbers used in the FF&E plans. FF&E Presentation boards are not required. Minutes of this meeting with photos of the approved FF&E concept must be submitted to the NAVFAC Interior Designer within 7 business days.

1.5.4 Best Value Determination(BVD) Pricing Solicitation "Over the Shoulder Review"

After implementing all feedback from the FF&E Concept Presentation to the Activity, the Prime Contractor's Interior Designer will prepare a pricing solicitation package, using the provided NAVFAC templates, for use in soliciting FF&E pricing and determining a best value vendor. The Prime Contractor's Interior Designer must submit one electronic copy of the BVD Analysis Request for Pricing Cover Letter (live WORD document), one printed hard copy, in binder format, of the entire pricing solicitation package, and one book-marked, pdf format, electronic copy of the entire pricing solicitation package to the NAVFAC Interior Designer for an "over-the-shoulder" review. If the Prime Contractor intends to attach an example of their subcontract agreement to the package, a copy of the subcontract agreement must be included in this submittal. This submittal must be approved by NAVFAC prior to requesting pricing.

BVD Pricing Solicitation must include the following;

a. BVD Analysis Request for Pricing cover letter:

The NAVFAC Cover Letter template must be used and highlighted areas must be edited, as required for the specific project. The electronic version of this submittal must include a "live" WORD document of the letter with all revisions indicated by "tracked changes". Information to clarify the scope can be added to the NAVFAC template provided; but no information should be deleted from the template without discussion with the NAVFAC Interior Designer.

1. The Contractor's Interior Designer must coordinate a proposed FF&E "hold pricing" timeframe, up to 12 months, with the Prime Contractor, based on the construction schedule. The "hold pricing" timeframe must be requested in the BVD Analysis Request for Pricing cover letter. If a known price increase is expected, and vendor pricing cannot be held for the "hold pricing" timeframe requested, then the proposed vendor pricing must reflect the anticipated price increase(s). All anticipated price increases during the "pricing hold" period must be funded in the FF&E planned modification. Manufacturer's documentation on the GSA price increase(s) and effective dates must be provided to NAVFAC.

- b. BVD Analysis Request for Pricing Spreadsheet/Questionnaire:
- Item numbers must be updated to reflect all required FF&E items and tagged to coordinate with updated FF&E Plans. Spreadsheet info must include: Item Tag #, Basic Item Name/Brief Description, Basis of Design Manufacturer Name/Series/Product #, and a representative photo. Clear references to the applicable performance criteria should be

provided below each item description.

c. Performance Criteria:

Non-proprietary, technical, performance criteria must be created for each FF&E item, or each item category, to establish minimum acceptable FF&E requirements. Adequate level of detail must be provided so that comparable and competitive pricing can be obtained from at least three GSA Holders vendors. Criteria must clearly reference the applicable FF&E item tags on the BVD Analysis Request for Pricing Spreadsheet and FF&E plans.

1. Project Specific Workstation/Desk Typical:

Typicals for each item are required to include: a description, dimensioned plans with power, data and grommet locations, detailed elevations and isometric views, etc. as necessary to communicate the desired layout and power, data and grommet locations. Typical must clearly reference the applicable FF&E item tags on the BVD Analysis Request for Pricing Spreadsheet and FF&E plans.

d. Updated FF&E Plans:

FF&E Plans must be transferred to the Contractor's Interior Designer's title block with a legend coded to the updated FF&E item numbers used on the BVD Analysis Request for Pricing Spreadsheet. All Collateral equipment (CEQ), to include Audio Visual equipment, Government Furnished, Government Installed (GFGI) equipment such as printers and vending machines and Government Furnished, Contractor Installed (GFCI) equipment, must be indicated on drawings for coordination purposes.

e. Copies of Electrical Power, Telecommunication, and A/V Plans and Details must be included in the package for coordination purposes.

1.5.5 BVD Vendor Recommendation and "Over the Shoulder Review"

The Prime Contractor's Interior Designer must submit one hard copy and one book-marked PDF copy of this submittal to the NAVFAC Interior Designer. Book-marked PDF copies must also be sent to the NAVFAC Construction Manager and the NAVFAC Contracting Officer.

The Prime Contractor's Interior Designer must schedule an "Over the Shoulder" review conference call to review the results of the GSA holder Pricing Solicitation and discuss the best value vendor recommendation. The NAVFAC Contracting Officer must provide verbal approval of the GSA holder recommendation during this call. If clarifications, updates or revisions are required, documentation must be revised and resubmitted. This submittal should include the following:

a. Binder Cover Page/Spine Identification (Project name, Project #, Location, Submittal date, Submittal title)

b. BVD Analysis Request for Pricing Spreadsheets/Questionnaires, as submitted by the three highest rated GSA holder.

c. Documentation showing that all required GSA holder sources, including UNICOR, in the appropriate SIN category were contacted (copy of the email solicitation).

d. Bid Response from UNICOR, if received.

e. Completed BVD Analysis Pricing Evaluation Spreadsheet, comparing ALL vendor pricing and responses in a side-by-side format. This spreadsheet must highlight proposed items that do not meet the required performance criteria, indicate specific proposal shortcomings, indicate the recommended GSA holder, and highlight key factors supporting the best value GSA holder recommendation. Open Market items and items that do not comply with the Buy America Act or Trade Agreement Act, must be indicated.

f. Back-up information submitted by each bidder. (cut sheets/highlighted pricing sheets/technical specifications, pricing, dealer and manufacturer qualifications for each product showing that product meets all requirements). Provide in cd format and include in the binder for the NAVFAC Interior Designer.

g. A comprehensive written statement outlining the evaluation of each vendor's proposal and the key factors supporting the best value GSA holder recommendation.

1.5.6 Vendor Recommendation Letter and De-Briefs

Following the approval of the GSA holder recommendation, the Contractor's Interior Designer must send out notification to the GSA holder who submitted pricing proposals and provide de-briefs to vendors, if requested. Templates for these notification letters and guidance for a standard de-brief can be provided by the NAVFAC Interior Designer.

1.5.7 Preliminary FF&E Submittal

Once the best value vendor recommendation has been made, the Prime Contractor's Interior Designer must work in conjunction with the recommended vendor to develop the FF&E package that will be procured for the project. This package must be presented to the Activity and NAVFAC in loose format at a meeting to occur at the Activity, located in Naval Station Newport, Newport, Rhode Island. Recommended FF&E finish and fabric samples for all major FF&E items should also be presented with large samples of the building interior finishes available for reference. All final product decisions, accessory additions and finish selections must be finalized at this meeting. Once Activity and NAVFAC feedback are implemented into the package, the Preliminary FF&E package must be submitted, in binder format, for review and comment.

Quantity of submittals required:

Provide one binder and one bookmarked electronic copy for both the NAVFAC Interior Designer and the Activity. Provide bookmarked electronic copies only for the Construction Manager and Contracting Officer.

The Preliminary FF&E Submittal must include the following:

- a. Binder Cover Page/Spine Identification (Project name, Project #, Location, Submittal date, Submittal title)
- b. Table of Contents and Identification Tabs for each section.
- c. Point of Contact List to include contact info for recommended GSA holder(s), subcontractors and manufacturers.

- d. Preliminary FF&E Cost Summary to include shipping, freight, handling, professional installation, project management, HAR, SIOH and applicable sales tax. Cost summary template will be provided by the NAVFAC Interior Designer.
- e. Procurement Data "spec" Sheets for each product indicating item number, item manufacturer/series/product number, detailed item description, quantity, room location, general appearance, and proposed finish and fabric selections. Procurement Data Sheet template will be provided by NAVFAC Interior Designer. Creation of these Procurement Data Sheets is the responsibility of the Contractor's Interior Designer; not the GSA holder or dealership. Item costs listed on Procurement Data Sheets must exactly match costs on the Bill of Materials from each vendor.
- f. Updated FF&E Plans coded to the FF&E Cost Summary List and Procurement Data Sheets. All sizes and configurations of the FF&E to be provided should be reflected on these updated plans. All Collateral equipment (CEQ), to include Audio Visual equipment, Government Furnished, Government Installed (GFGI) equipment such as printers and vending machines and Government Furnished, Contractor Installed (GFCI) equipment must be indicated on drawings for coordination purposes.
- g. FF&E Cost Comparison worksheet, listing all cost differences between bid pricing and final pricing, with justifications.
- h. Updated Electrical and Telecommunication Plans: Provide dimensioned locations on plans and elevations for Multi-user Telecommunications Outlet Assemblies (MUTOAs), junction boxes, wall outlets and floor boxes, based on the sizes, layouts and configurations of the FF&E items to be provided.
- i. Performance Criteria for all FF&E that was used in the BVD Pricing Solicitation.
- j. Finish and fabric samples for all FF&E items attached to 8-1/2 inch x 11 inch mat boards and inserted into heavy duty plastic sheet protectors. All samples must have the manufacturer names and numbers listed and must reference the FF&E Item tags on the Procurement Data Sheets. Actual finish and fabric samples are required.
- k. Copy of Manufacturer Bill of Materials (BOM) on manufacturer letterhead for each vendor. Bill of Materials must be coded to the FF&E Cost Summary Item codes. Sum of all manufacturer's Bill of Material totals must match Cost Summary totals exactly. All fees and taxes must be indicated on the BOM. If more than one Bill of Materials is provided, a summary list/spreadsheet listing all manufacturers and their BOM totals should be provided as a separate document.
- l. Best Value Determination Guideline sheets; completed and signed by the Contractor's Interior Designer. Templates and guidance can be found at:

<http://www.wbdg.org/ffc/navy-navfac/collateral-equipment>

1.5.8 Final FF&E Submittal

The Final FF&E package must be submitted four months prior to the funding deadline (to be determined by funding source) and approved no later than nine months prior to the Contract Completion Date.

Once Activity and NAVFAC feedback are implemented into the package, the Final FF&E package must be submitted, in binder format, for review and approval.

Quantity of submittals required:

Provide one binder and one bookmarked electronic copy each for the NAVFAC Interior Designer and the Activity. Provide one bookmarked electronic copy for the Construction Manager

The Final FF&E Submittal must include the following:

- a. Binder Cover Page/Spine Identification (Project name, Project #, Location, Submittal date, Submittal title)
- b. Table of Contents and Identification Tabs for each section.
- c. Point of Contact List to include contact info for recommended GSA holder(s), subcontractors and manufacturers.
- d. Final FF&E Cost Summary to include shipping, freight, handling, professional installation, project management, HAR, SIOH, and applicable sales tax. A region-specific cost summary template will be provided by the NAVFAC Interior Designer.
- e. Final Procurement Data "Spec" Sheets for each product indicating item number, item manufacturer/series/product number, detailed item description, quantity, room location, general appearance, and proposed finish and fabric selections. Procurement Data Sheet template will be provided by NAVFAC Interior Designer. Creation of these Procurement Data Sheets is the responsibility of the Contractor's Interior Designer; not the GSA holder or dealership. Item costs listed on Procurement Data Sheets must match costs on Cost Summary and costs on the Bill of Materials from each vendor.
- f. Final updated FF&E Plans coded to the FF&E Cost Summary List and Procurement Data Sheets. All sizes and configurations of the FF&E to be provided should be reflected on these updated plans. All Collateral equipment (CEQ), to include Audio Visual equipment, Government Furnished, Government Installed (GFGI) equipment such as printers and vending machines and Government Furnished, Contractor Installed (GFCI) equipment must be indicated on drawings for coordination purposes.
- g. FF&E Final Cost Comparison worksheet, listing all cost differences between bid pricing and final pricing with justifications.
- h. Updated Electrical and Telecommunication Plans: Provide dimensioned locations on plans and elevations for Multi-user Telecommunications Outlet Assemblies (MUTOAs), junction boxes, wall outlets and floor boxes, based on the sizes, layouts and configurations of the FF&E items to be provided.

- i. Performance Criteria for all FF&E that was used in the BVD Pricing Solicitation.
- j. Finish and fabric samples for all FF&E items attached to 8-1/2 inch x 11 inch mat boards and inserted into heavy duty plastic sheet protectors. All samples must have the manufacturer names and numbers listed and must reference the FF&E Item tags on the Procurement Data Sheets. Actual finish and fabric samples are required.
- k. Copy of Manufacturer Bill of Materials (BOM) on manufacturer letterhead for each vendor. Bill of Materials must be coded to the FF&E Cost Summary Item codes. Sum of all manufacturer's Bill of Material totals must match Cost Summary totals and Procurement Data sheets exactly.
- l. Best Value Determination Guideline sheets; completed and signed by the Contractor's Interior Designer. Templates and guidance can be found at:

<http://www.wbdg.org/ffc/navy-navfac/collateral-equipment>

1.6 BEST VALUE DETERMINATION

A Best Value Determination (BVD) is required by FAR 8.404 when placing orders against Federal Supply Schedules for the selection of furniture and furnishings. Best Value is defined in FAR 2.101 as ensuring that the order to be placed under a Federal Supply Schedule results in the lowest overall cost alternative (considering quality, price, special features, administrative costs and client's functionality) to meet the government's needs.

- a. A (BVD) must be performed on a minimum of three manufacturers for orders exceeding a total procurement of \$10,000 from an individual manufacturer. Multiple BVDs may be required in order to complete the final FF&E package.
- b. The required quantity of BVD's to be performed will be determined by the NAVFAC Interior Designer and as necessary to support the construction schedule during the design phase and is dependent on the appropriate GSA holder category(s) to be utilized and specific project requirements.
- c. Documentation must be provided to the Government with the final FF&E package. Specific Documentation is indicated in the BVD Vendor Recommendation and the Final FF&E Submittal. The Best Value Determination Guidelines form must be completed and signed by the Contractor's Interior Designer.

1.6.1 BVD Justifications

The Prime Contractor's Interior Designer is responsible for the following written BVD justifications:

For FF&E procurements with a value of \$10,000 or less, the Interior Designer may utilize any current GSA holder. If none of the GSA holders can supply the item, then any other manufacturer may be utilized.

For FF&E procurements with a value greater than \$10,000 and \$250,000 or

less, the Prime Contractor's Interior Designer must always review published pricing from at least three current GSA holders, in the applicable SIN Category and Region. Pricing from Federal Prison Industries (UNICOR) must also be requested, via email, and reviewed if UNICOR holds a GSA in the applicable SIN Category. Documentation of the email to UNICOR is required. In addition to the review of published list prices, the Contractor's Interior Designer must confirm the pricing with the vendor via a written quote. The BVD Guidelines Micro Purchase Threshold - Simplified Acquisition Threshold form must be completed and submitted for all FF&E procurements greater than \$10,000 and \$250,000 or less.

For FF&E procurements greater than \$250,000, UNICOR and all GSA holders in the applicable SIN Category and Region must always be solicited. Documentation of the email to UNICOR is required. The Prime Contractor's Interior Designer must develop a Request for Proposal pricing package complete with non-proprietary performance criteria and project requirements based on a generic design. This Request for Proposal must have adequate information for the GSA holders and UNICOR to develop an FF&E price and performance proposal and must be distributed to all GSA holders in the applicable SIN Category and Region. The BVD Guidelines Greater than Simplified Acquisition Threshold form must be completed and submitted for all FF&E procurements greater than \$250,000 and manufacturer's quotes and a summary of all proposals must be attached.

1.6.2 Evaluation Factors

The Best Value Determination must address issues such as:

- a. Space planning; human factors data related to anthropometrics (reach, clearance, adjustability), space, and acoustics.
- b. Ergonomics.
- c. Product quality (including construction and materials); sustainability features, product warranties; history of the product and/or manufacturer.
- d. Ability to service products through dealers or others within a certain geographical range of the project.
- e. Price (including freight, design, project management and installation).
- f. Aesthetics.
- g. Appropriateness; lighting, power and telecommunications systems management and/or coordination as related to the facility (when applicable); and other project specific factors as identified and/or required.
- h. The goal is to create a fully integrated design solution by providing quality FF&E products to meet the functional needs of the customer. Customer preferences must be considered. The focus must be on the best overall value. Use of the NAVFAC Best Value Determination form templates provided by the NAVFAC Interior Designer, is required.

PART 2 FF&E TURNKEY EFFORT

2.1 FF&E and A/V PACKAGE PLANNED MODIFICATION

FF&E Planned Modification: As a planned modification, provide procurement and installation coordination of the complete and usable Final FF&E and A/V package. The FF&E and A/V Package must include shipping, freight, handling, installation and the Prime Contractor's FF&E Handling and Administration Rate (HAR) percentage as applied to the final FF&E total cost and sales tax, if applicable.

- a. The Audio Visual (AV) Equipment will be identified as a separate line item, priced separately from the FF&E and funded as a separate planned modification. The A/V Package must include shipping, freight, handling, installation, applicable state sales tax, and the Prime Contractor's A/V Handling and Administration Rate (HAR) percentage as applied to the final A/V total cost (excluding taxes).

2.1.1 Authorization

The Government will provide separate funding for procurement and installation coordination of the FF&E and A/V packages. Construction funds will not be used. Upon receipt of required funding, the Prime Contractor will be authorized by the Contracting Officer, as a planned modification to the construction contract, to procure and install all Final FF&E and A/V utilizing GSA schedules, and other Federal contracts and complying with priorities found in FAR Part 8.404. The Prime Contractor will be expected to procure and coordinate the installation of the approved Final FF&E and A/V package exactly as specified, or NAVFAC approved equal. The amount of the modification will be the actual cost of these items from the Federal Government price schedules (GSA), including any freight and installation charges from the furniture supplier as well as the Prime Contractor's Handling and Administration Rate (HAR) and any applicable state sales tax. The HAR must cover all of the Prime Contractor's effort related to storage, coordination, handling, administration of subcontractors, and all other associated costs and profit for the procurement of FF&E and A/V.

The Government will indicate the FF&E and A/V preliminary estimates. These Government estimates must not be altered by Prime Contractors during the bid process. Prime Contractors must propose a HAR only. The Prime Contractor's proposed HAR may not exceed 5 percent of the total FF&E costs. The proposed HAR percentage will be incorporated into the contract award and will not be adjusted regardless of fluctuations from the estimate amount for the FF&E and A/V. The proposed HAR is a fixed percentage rate.

The HAR must not include costs associated with the effort required in Part 1.4 INTERIOR DESIGN SERVICES.

FF&E items are subject to the Buy American Act or Trade Agreement Act, unless they are considered COTS (Consumer Off The Shelf) items by the Contracting Officer.

2.1.2 Procurement, Installation Schedule and Price Increases

The Prime Contractor and Contractor's Interior Designer must coordinate the building completion date with the installation dealer(s) specified in the FF&E Package and keep the NAVFAC Interior Designer updated on the status. FF&E product should be ordered as soon as the planned modification is awarded to avoid incurring additional costs for price

increases. Delayed production and phased delivery dates can be coordinated with the installation dealer at the time of order placement, to coincide with the contract completion date.

The Prime Contractor must anticipate possible manufacturer price increases if order placement is delayed. Any costs incurred due to manufacturer price increases after the FF&E planned modification will be the burden of the Prime Contractor. Any FF&E storage costs incurred due to construction delays and lack of communication with the installation dealer are the responsibility of the Prime Contractor.

2.1.3 Use of GSA Schedules

The Prime Contractor will receive a letter of authorization from the Contracting Officer citing the name of the furniture dealer(s) and authorization to access the Federal Government supply sources.

2.1.4 Deposits

The Prime Contractor must anticipate providing a deposit(s) of between 30 percent and 50 percent of the FF&E costs when placing the orders with the manufacturer's dealerships.

2.1.5 Davis Bacon Wages

Davis Bacon wages do not apply to the FF&E installer from the Government supply sources. The workforce for the FF&E installation and delivery must be separate and distinct from the labor workforce performing under the construction contract.

2.1.6 Sales Tax

The Prime Contractor must take maximum advantage of all exemptions from State and Local taxation authorities whether available to it directly or available to the Prime Contractor based on an exemption afforded the Government. The responsibility for paying applicable taxes rests with the Prime Contractor. Any state and local taxes applicable to the FF&E must be included within the FF&E Dealer's quote and funded in the FF&E planned modification. Any items purchased as building materials, such as carpet, are taxable.

2.1.7 Bonds

FF&E items are not considered construction and the Prime Contractor is not required by the Government to secure any additional bonds for the award of the FF&E line item, unless otherwise indicated in the contract. If any additional bond is required for the FF&E line item it is to be included in the Prime Contractor's FF&E HAR.

2.1.8 Unique Item Identification (IUID) and Valuation

Unique item identification and valuation is a system of marking and valuing items delivered to DoD that enhances logistics, contracting, and financial business transactions. The IUID policy is mandatory for all DoD contracts that require the delivery of items. An item is a single article or a single unit formed by a grouping of subassemblies, components, or constituent parts. The Prime Contractor must provide DoD Unique item identification, valuation and delivery of data for all required FF&E items for which the government's unit acquisition cost is \$5,000 or more. This

information must be provided in the Ordering Documentation referenced in Section 3.3 at the final FF&E punch list site visit.

PART 3 EXECUTION

3.1 Installation

The FF&E package includes the installation of all furniture and furnishings as specified in the FF&E package. The FF&E installation dealer(s) specified in the FF&E package must receive, store as required, transport to the project site, off load, inside deliver, unpack, assemble, place/install, clean, and dispose of all the trash for all FF&E package. It is the Prime Contractor's responsibility to coordinate the building completion, occupancy, and furniture installation dates with the installation dealer(s) specified in the FF&E package. Any costs associated with or delaying FF&E shipments is the responsibility of the Prime Contractor.

3.2 Installation Warranty

All FF&E and A/V must be installed in accordance with the manufacturer's instructions and warranty requirements. All FF&E and A/V must be leveled and aligned. All doors, drawers and accessories must be leveled and aligned to open, close and otherwise operate smoothly and securely.

All FF&E and A/V must be installed by the furniture manufacturer's dealer of record and not the Prime Contractor. The Government reserves the right to approve/disapprove the Prime Contractor's FF&E installers. In addition, dealer, teaming partners and installation team(s) must be located within a 250 mile radius of the project site, unless approved by the NAVFAC Interior Designer. The Prime Contractor must repair, to the Government's satisfaction, any/all damage to any facility finish that is a result of the furniture installation and correct all punch list items for the FF&E and A/V. The Prime Contractor must obtain services of equipment specialists to install the electrical equipment, to include but not limited to televisions, Video Teleconference Equipment, ceiling mounted projectors, and mission essential electronic equipment included in the FF&E and A/V package.

3.3 Ordering Documentation

After award of the FF&E and A/V packages, two CD copies of all ordering documentation, including Factory Order number (FO), warranty information and operating instructions for all products, must be provided to the Contracting Officer at the final FF&E punch list walk-thru.

3.4 Post Award Changes

The Government requires the Prime Contractor to provide FF&E and A/V items exactly as specified in the Final FF&E and A/V submittals and as awarded in the FF&E planned modification. Should changes become necessary, careful consideration is essential to assure that equivalent quality, price and functionality of the item are maintained. Coordination with building finishes and other FF&E items is required for all proposed substitutions. Information on specific item type, quality, color, finish, fabric, price, sustainability, life cycle, and dealership service must be provided to the NAVFAC Interior Designer for item approval. After award of the FF&E planned modification, any request to change the FF&E items which affects the price of the item must be negotiated and may not be funded. The Prime

Contractor must obtain approval from the NAVFAC Interior Designer and the Contracting Officer for any changes to the FF&E Package.

Post award FF&E manufacturer's price increases, beyond the "hold pricing" date, are the responsibility of the Prime Contractor and must not be transferred to the Government.

3.5 Punch List

The Contractor, his Interior Designer (and A/V consultant or other specialty consultants, if applicable) must attend at least one punch list site visit with the installation dealer(s), NAVFAC Interior Designer and the Base Representative/Activity Contact. The first site visit must identify all punch list items (at installation dealer's 98 percent completion).

-- End of Section --

SECTION 01 31 23.13 20

ELECTRONIC CONSTRUCTION AND FACILITY SUPPORT CONTRACT MANAGEMENT SYSTEM
05/17, CHG 6: 02/21

PART 1 GENERAL

1.1 CONTRACT ADMINISTRATION

Utilize the Naval Facilities Engineering Systems Command's (NAVFAC's) Electronic Construction and Facility Support Contract Management System (eCMS) for the transfer, sharing and management of electronic technical submittals and documents. The web-based eCMS is the designated means of transferring technical documents between the Contractor and the Government. Paper media or e-mail submission, including originals or copies, of the documents identified in Table 1 are not permitted, except where eCMS is unavailable, non-functional or specifically requested in addition to electronic submission. When specifically requested to provide documents outside of eCMS, upload all final project documentation (e.g. documents that are signed and/or adjudicated by the Government) mentioned in Table 1 into the subject eCMS document management folders that are associated with that document type. Include the identification number of the document, type of document; the name/subject or title; and for daily reports the date (day of work) with format YYYY/MM/DD in the filename. For example for RFI's 0011_RFI_Roof_Leaking.doc; For submittals 0032a_Submittals_Light_Fixture.pdf; For Daily Reports 0132_Daily_Report_20190504.xls. Contact the Contracting Officer's Representative (COR) regarding availability of eCMS training and reference materials.

1.2 USER PRIVILEGES

The Contractor will be provided access to eCMS. All technical submittals and documents must be transmitted to the Government via the COR. Project roles and system roles will be established to control each user's menu, application, and software privileges, including the ability to create, edit, or delete objects.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

List of Contractor's Personnel; G

1.4 SYSTEM REQUIREMENTS AND CONNECTIVITY

1.4.1 General

The eCMS requires a web-browser (platform-neutral) and Internet connection. Obtain from an approved vendor an External Certification Authority (ECA), Primary Key Infrastructure (PKI) certificate, or other similar digital identification to support two-factor authentication and access to eCMS. Provide and maintain computer hardware and software for

the eCMS access throughout the duration of the contract for all Contractor-designated users. Provide connectivity, speed, bandwidth, and access to the Internet to ensure adequate functionality. Neither upgrading of the Contractor's computer system nor delays associated from the usage of the eCMS will be justification or grounds for a time extension or cost adjustment to the Contract.

1.4.2 Contractor Personnel List

Within 20 calendar days of contract award, provide to the Contracting Officer a list of Contractor's personnel who will have the responsibility for the transfer, sharing and management of electronic technical submittals and documents and will require access to the eCMS. Project personnel roles to be filled in the eCMS include the Contractor's Project Manager, Superintendent, Quality Control (QC) Manager, and Site Safety and Health Officer (SSHO). Personnel must be capable of electronic document management. Notify the COR immediately of any personnel changes to the project. The Contracting Officer reserves the right to perform a security check on all potential users. Provide the following information:

First Name

Last Name

E-mail Address

Office Address

Project Role (e.g. Project Manager, QC Manager, Superintendent)

1.4.3 Field Administration

Within 30 days of Contract Award, provide a tablet computer with a Common Access Card (CAC) reader at the job site for Government use only. The tablet computer must have a web-browser, built-in camera, and cellular data connectivity. Provide tablet computer with a rugged case suitable for use in a construction environment. The tablet computer must be fully charged and made available at all times for Government use to facilitate the input of construction data at the job site. The tablet will be given back to the contractor prior to leaving the jobsite for charging, maintaining and securing. After completion of the work, reset the tablet computer to factory default settings. The tablet computer remains the property of the Contractor and must be removed from the site. There are restrictions on use of WIFI on military bases. Cellular data connectivity and availability, and use of WIFI requires coordination with and approval by the Contracting Officer.

1.5 SECURITY CLASSIFICATION

In accordance with Department of Navy guidance, all military construction contract data are unclassified, unless specified otherwise by a properly designated Original Classification Authority (OCA) and in accordance with an established Security Classification Guide (SCG). Refer to the project's OCA when questions arise about the proper classification of information.

The eCMS and tablet computer must only be used for the transaction of unclassified information associated with construction projects. In conformance with the Freedom of Information Act (FOIA), DoD INSTRUCTION 5200.48 CONTROLLED UNCLASSIFIED INFORMATION (CUI), and DoD requirements, any unclassified project documentation uploaded into the eCMS must be designated either "U - UNCLASSIFIED" (U) or "CUI - CONTROLLED UNCLASSIFIED INFORMATION"

(CUI).

1.6 ECMS UTILIZATION

Establish, maintain, and update data and documentation in the eCMS throughout the duration of the contract.

Personally Identifiable Information (PII) transmittal is not permitted in the eCMS.

1.6.1 Information Security Classification/Identification

The eCMS must be used for the transmittal of the following documents. This requirement supersedes conflicting requirements in other sections, however, submittal review times in Section 01 33 00 SUBMITTAL PROCEDURES remain applicable. Table 1 - Project Documentation Types provides the appropriate U and CUI designations for various types of project documents. Construction documents requiring CUI status must be marked accordingly. Apply the appropriate markings before any document is uploaded into eCMS. Markings are not required on U documents.

Table 1 also identifies which eCMS application is to be used in the transmittal of data (these are subject to change based on the latest software configuration). If a designated application is not functional within 4 hours of initial attempt, defer to the Submittal application and submit the required data as an uploaded portable document (e.g. PDF), word processor, spreadsheet, drawing, or other appropriate format. Hard copy or e-mail submission of these items is acceptable only if eCMS is documented to be not available or not functional or specifically requested in addition to electronic submission. After uploading documents to the Submittal application, transmit the submittals and attachments to the COR via the Transmittal application. For Submittals, select the following:

Preparation by = Contractor personnel assigned to prepare the submittal
Approval by = Contracting Officer Representative (COR)
Returned by = Design Lead/Manager
Forwarded to = Contractor project manager

Table 1 - Project Documentation Types

SUBJECT/NAME	DESIG	REMARKS	ECMS APPLICATION
As-Built Drawings	U	Locations of sensitive areas must be labeled as either "Controlled Area" or "Restricted Area" and may be shown on unclassified documents with the approval from Site Security Manager	Submittals and Transmittals

SUBJECT/NAME	DESIG	REMARKS	ECMS APPLICATION
Building Information Modeling (BIM)	U	1. Locations of sensitive areas must be labeled as either "Controlled Area" or "Restricted Area" and may be shown on unclassified documents with the approval from Site Security Manager 2. Design reviews will be performed in existing "Dr Checks"	Submittals and Transmittals
Construction Permits	U	Refer to rules of the issuing activity, state or jurisdiction	Submittals and Transmittals
Construction Schedules (Activities and Milestones)	U	After the schedule submittal is approved by the COR, import the schedule file into the scheduling application, and select "Approve" to establish a new schedule baseline	Submittals, Transmittals and Scheduling App
Construction Schedules (Cost-Loaded)	CUI	After the schedule submittal is approved by the COR, import the schedule file into the scheduling application, and select "Approve" to establish a new schedule baseline	Submittals, Transmittals and Scheduling App
Construction Schedules (3-Week Lookahead)	U	Import the schedule file into the scheduling application, and select "Approve" to establish a new schedule baseline	Scheduling App
DD 1354 Transfer of Real Property	U		Submittals and Transmittals
Daily Production Reports	CUI	Provide weather conditions, crew size, man-hours, equipment, and materials information	Daily Report
Daily Quality Control (QC) Reports	CUI	Provide QC Phase, Definable Features of Work Identify visitors	Daily Report
Designs and Specifications	U	1. Locations of sensitive areas must be labeled as either "Controlled Area" or "Restricted Area" and may be shown on unclassified documents with the approval from Site Security Manager 2. Design reviews will be performed in existing "Dr Checks"	Submittals and Transmittals

SUBJECT/NAME	DESIG	REMARKS	ECMS APPLICATION
Environmental Notice of Violation (NOV), Corrective Action Plan	U	Refer to rules of the issuing activity, state or jurisdiction	Submittals and Transmittals
Environmental Protection Plan (EPP)	CUI		Submittals and Transmittals
Invoice (Supporting Documentation)	CUI	Applies to supporting documentation only. Invoices are submitted in Wide-Area Workflow (WAWF)	Submittals and Transmittals
Jobsite Documentation, Bulletin Board, Labor Laws, SDS	U		Submittals and Transmittals
Meeting Minutes	CUI		Meeting Minutes
Modification Documents	CUI	Provide final modification documents for the project. Upload into "Modifications - RFPs"	Document Management
Operations & Maintenance Support Information (OMSI/eOMSI), Facility Data Worksheet	U	1. Locations of sensitive areas must be labeled as either "Controlled Area" or "Restricted Area" and may be shown on unclassified documents with the approval from Site Security Manager 2. Design reviews will be performed in existing "Dr Checks"	Submittals and Transmittals
Photographs	U	Subject to base/installation restrictions	Submittals and Transmittals
QCM Initial Phase Checklists	CUI		Checklists (Site Management)
QCM Preparatory Phase Checklists	CUI		Checklists (Site Management)
Quality Control Plans	CUI		Submittals and Transmittals
QC Certifications	U		Submittals and Transmittals

SUBJECT/NAME	DESIG	REMARKS	ECMS APPLICATION
QC Punch List	U		Punch Lists (Testing Logs)
Red-Zone Checklist	U		Checklists (Site Management)
Rework Items List	CUI		Punch Lists (Testing Logs)
Request for Information (RFI) Post-Award	CUI		RFIs
Safety Plan	CUI		Daily Report
Safety - Activity Hazard Analyses (AHA)	CUI		Daily Report
Safety - Mishap Reports	CUI		Daily Report
SCIF/SAPF Accreditation Support Documents	CUI	Note: Some Construction Security plans may be classified as Secret. Classified information must not be uploaded into eCMS. Refer to the Site Security Manager, as applicable.	Submittals and Transmittals
Shop Drawings	U	Locations of sensitive areas must be labeled as either "Controlled Area" or "Restricted Area" and may be shown on unclassified documents with the approval from Site Security Manager	Submittals and Transmittals
Storm Water Pollution Prevention (Notice of Intent - Notice of Termination)	U	Refer to rules of the issuing activity, state or jurisdiction	Submittals and Transmittals
Submittals and Submittal Log	U		Submittals and Transmittals
Testing Plans, Logs, and Reports	CUI		Submittals and Transmittals
Training/Reference Materials	U		Submittals and Transmittals

SUBJECT/NAME	DESIG	REMARKS	ECMS APPLICATION
Training Records (Personnel)	CUI		Submittals and Transmittals
Utility Outage/Tie-In Request/Approval	CUI		Submittals and Transmittals
Warranties/BOD Letter	CUI		Submittals and Transmittals
Quality Assurance Reports	CUI		Checklists (Government initiated)
Non-Compliance Notices	CUI		Non-Compliance Notices (Government initiated)
Other Government-prepared documents	CUI		GOV ONLY
All Othere Documents	CUI	Refer to FOIA guidelines and contact the FOIA official to determine whether exemptions exist	As applicable

1.6.2 Markings on CUI documents

- a. Only CUI documents being electronically uploaded into the eCMS (.docx, .xlsx, .ppt and others as appropriate), and associated paper documents described in the paragraph CONTRACT ADMINISTRATION require CUI markings as indicated in the subparagraphs below.
- b. CUI documents that are originally created within the eCMS application using the web-based forms (RFIs, Daily Reports, and others as appropriate) will be automatically watermarked by the eCMS software, and these do not require additional markings.
- c. CUI documents must be marked "CONTROLLED UNCLASSIFIED INFORMATION" at the bottom of the outside of the front cover (if there is one), the title page, the first page, and the outside of the back cover (if there is one).
- d. CUI documents must be marked on the internal pages of the document as "CONTROLLED UNCLASSIFIED INFORMATION" at top and bottom.
- e. Where Installations require digital photographs to be designated CUI, place the markings on the face of the photograph.
- f. For visual documentation, other than photographs and audio documentation, mark with either visual or audio statements as appropriate at both the beginning and end of the file.

1.7 QUALITY ASSURANCE

Requested Government response dates on Transmittals and Submittals must be in accordance with the terms and conditions of the Contract. Requesting response dates earlier than the required review and response time, without concurrence by the Government COR, may be cause for rejection.

Incomplete submittals will be rejected without further review and must be resubmitted. Required Government response dates for resubmittals must reflect the date of resubmittal, not the original submittal date.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 01 32 17.00 20

COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS)
05/18, CHG 3: 08/20

PART 1 GENERAL

1.1 DEFINITIONS

The cost-loaded Network Analysis Schedule (NAS) is a tool to manage the project, both for Contractor and Government activities. The NAS is also used to report progress, evaluate time extensions, and provide the basis for progress payments.

For consistency, when scheduling software terminology is used in this section, the terms in Primavera's scheduling programs are used.

1.2 SCHEDULE REQUIREMENTS PRIOR TO THE START OF WORK

1.2.1 Preliminary Scheduling Meeting

Before preparation of the Project Baseline Schedule, and prior to the start of work, meet with the Contracting Officer to discuss the proposed schedule and the requirements of this section. Propose projected data dates for monthly update schedules for the project and incorporate each monthly update submittal into submittal register. Discuss required forms, terminology, and submittal requirements of this section and other requirements related to schedule management for this contract.

1.2.2 Project Baseline Schedule

Submit the Baseline NAS within 45 calendar days after contract award. Data date must be set to contract award date and no progress statused for any activity. Only bonds may be paid prior to acceptance of the Baseline NAS. The acceptance of a Baseline NAS is a condition precedent to:

- a. The Contractor starting demolition work or construction stage(s) of the contract.
- b. Processing Contractor's invoices(s) for any items other than bonds.
- c. Review of any schedule updates.

Submittal of the Baseline NAS is the Contractor's certification that the submitted schedule meets the requirements of the Contract Documents and represents the Contractor's plan on how the work will be accomplished. Provide all items listed in paragraph REQUIRED TABULAR REPORTS AND NATIVE P6 XER FILES with baseline NAS submittal.

1.3 THREE-WEEK LOOK AHEAD SCHEDULE

1.3.1 Weekly CQC Coordination and Production Meeting

Deliver electronic file of 3-Week Look Ahead Schedule to the Contracting Office at least 24 hours prior to the weekly scheduled CQC Coordination and Production Meeting. Contractor is required to provide all attendees at the CQC Coordination and Production Meeting with a hard copy of the 3-Week Look Ahead Schedule.

1.3.2 Look Ahead Schedule Requirements

Prepare and issue a 3-Week Look Ahead schedule to provide a more detailed day-to-day plan of upcoming work identified on the Project Network Analysis Schedule. Requirements include:

- a. For each Look Ahead schedule activity, identify parent NAS activity number(s). The parent NAS activity is the activity in the NAS that would incorporate the Look Ahead schedule activity requirement and or scope of work.
- b. Update schedule each week to show the planned work for the current and following two-week period. Also include previous week, as-built work, showing actual start and finish dates.
- c. Include upcoming outages, closures, preparatory meetings, and initial meetings, testing and inspections.
- d. Clearly identify longest path activities on the Three-Week Look Ahead Schedule. Include a key or legend that distinguishes longest path activities. Include all Longest Path activity NAS start/finish dates exceeded and/or occurring during this period.
- e. The detail work plans are to be bar chart type schedules, derived from but maintained separately from the Project NAS on an electronic spreadsheet program and printed on 11 by 17 inch sheets as directed by the Contracting Officer.
- f. Activities must not exceed 5 working days in duration and have sufficient level of detail to assign crews, tools and equipment required to complete the work.

1.4 MONTHLY NETWORK ANALYSIS

Submittal of Monthly NAS is the Contractor's certification that the submitted schedule meets the requirements of the Contract Documents and represents the Contractor's plan on how the work will be accomplished. Provide all items listed in paragraph REQUIRED TABULAR REPORTS AND NATIVE P6 XER FILES with the monthly NAS submittal.

1.4.1 Monthly Network Analysis Updates

- a. Regardless of whether an invoice is being submitted monthly, an updated schedule must be submitted monthly to the Government. The Monthly NAS update must be submitted within 10 calendar days of the data date.
- b. Provide all items listed in paragraph REQUIRED TABULAR REPORTS AND NATIVE P6 XER FILES, with each monthly NAS update submittal.
- c. Meet with Government representative(s) at monthly intervals to review and agree on the information presented in the updated project schedule. The submission of an accepted, updated schedule to the Government is a condition precedent to the processing of the Contractor's invoice.
- d. Activity progress must incorporate as-built events as they occurred and correspond to records including but not limited to submittals and

daily production and quality control reports. Software Settings: Handle schedule calculations and Out-of-Sequence progress (if applicable) through Retained Logic, not Progress Override. Show all activity durations and float values in days. Show activity progress using Remaining Duration. Set default activity type to "Task Dependent".

- e. Update schedule must reflect current Contract Completion Date and contract value in accordance with all conformed contract modifications issued prior to data date of NAS update.

1.4.2 As-Built Schedule

As a condition precedent to the release of retention and making final payment, submit an "As-Built Schedule," as the last schedule update showing all activities at 100 percent completion. This schedule must reflect the exact manner in which the project was actually constructed.

1.5 CORRESPONDENCE AND TEST REPORTS

Reference Schedule activity IDs that are being addressed in each correspondence (e.g., letters, Requests for Information (RFIs), e-mails, meeting minute items, Production and QC Daily Reports, material delivery tickets, photographs) and test report (e.g., concrete, soil compaction, weld, pressure).

1.6 ADDITIONAL SCHEDULING REQUIREMENTS

Other specification sections may include additional scheduling requirements, including systems to be inspected, tested and commissioned, and submittal procedures. Those schedule requirements must be incorporated into the NAS schedule.

1.7 SUBMITTALS

Government approval/acceptance is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Baseline NAS; G

Designated Project Scheduler; G

SD-07 Certificates

Three-Week Look Ahead Schedule; G

Monthly Network Analysis Updates; G

SD-11 Closeout Submittals

As-Built Schedule; G

1.8 SOFTWARE

Prepare and maintain project schedules using Primavera P6 software in a version compatible with Government's current version. Importing data into P6 using data conversion techniques or third party software is cause for rejection of the submitted schedule. Schedules with Performing Organizational Breakdown Structure (POBS) data is cause for rejection.

1.9 DESIGNATED PROJECT SCHEDULER

Within 30 calendar days of contract award, submit to the Contracting Officer for approval an individual who will serve as the Designated Project Scheduler. Include a copy of the candidate's resume with qualifications. The Contracting Officer may remove the Designated Project Scheduler, and require replacement, if the scheduler does not effectively fulfill their duties in accordance with the contract requirements. Payment request will not be processed without an approved Designated Project Scheduler.

1.9.1 Qualifications

The Designated Project Scheduler must have prepared and maintained at least three previous construction schedules, of similar size and complexity to this contract, using Primavera P6.

1.9.2 Duties

Duties of the Designated Project Scheduler:

- a. Prepare Baseline NAS.
- b. Prepare monthly schedule updates.
- c. Prepare tabular reports.
- d. Prepare Time Impact Analysis (TIA) as necessary.
- e. Provide certification that NAS and TIA submittals conform to the contract requirements.
- f. Participate with the Prime Contractor and Government Representative in a monthly teleconference call, and scheduled with sufficient time to support the Monthly Network Analysis Updates process, to discuss project status, schedule updates, critical activities, potential delays, and contract modifications impacting the schedule. Have a computer with P6 software available during the meeting.

1.10 NETWORK SYSTEM FORMAT

Prepare the schedule in accordance with the following Primavera P6 settings and parameters. Deviation from these settings and parameters, without prior consent of the Contracting Officer, is cause for rejection of schedule submission.

1.10.1 Schedule Activity Properties and Level of Detail

1.10.1.1 Activity Identification and Organization

- a. Identify design and construction activities planned for the project

and other activities that could impact project completion if delayed in the NAS.

- b. Each activity must have a unique name.
- c. Identify administrative type activity/milestones, including all pre-construction submittal and permit requirements prior to demolition or construction stage.
- d. Include times for procurement, Contractor quality control and construction, acceptance testing and training in the schedule.
- e. Include the Government approval time required for the submittals that require Government Approval prior to construction, as indicated in Section 01 33 00 SUBMITTAL PROCEDURES.
- f. Create separate activities for each Phase, Area, Floor Level and Location the activity is occurring.
- g. Do not use construction category activity to represent non-work type reference (e.g. Serial Letter, Request for Information) in NAS. Place Non-work reference within the P6 activity details notebook.

Activity categories included in the schedule are specified below.

1.10.1.2 Activity Logic

- a. With the exception of the Contract Award and Contract Completion Date (CCD) milestone activities, activity must not be open-ended; each activity must have at least one predecessor and at least one successor.
- b. Activities must not have open start or open finish (dangling) logic.
- c. Do not use lead or lag logic without Contracting Officer prior approval.
- d. Minimize redundant logic ties.
- e. Once an activity exists on the schedule it must not be deleted or renamed to change the scope of the activity and must not be removed from the schedule logic without approval from the Contracting Officer.
 - (1) While an activity cannot be deleted, where said activity is no longer applicable to the schedule, but must remain within the logic stream for historical record, change the activity original and remaining duration to zero and clearly label "(NO LONGER REQUIRED)" after the activity name. Actual finish date for activity that falls behind the data date. Redistribute accordingly any remaining budget associated with that activity, to other remaining appropriate activity.
 - (2) Document any such change in the activities' "Notebook," including a date and explanation for the change.
 - (3) The ID number for a "NO LONGER REQUIRED" activity must not be re-used for another activity.

1.10.1.3 Longest Path Activity Baseline Limitation

For P6 settings, critical activities are defined as being on the Longest Path. Longest Path (Critical) Activities must not make up more than 30 percent of all activity within the Construction Baseline Schedule.

1.10.1.4 Assigned Calendars

All NAS activity must be assigned calendars that reflect required and anticipated non-work days.

1.10.1.5 Activity Categories

1.10.1.5.1 Pre-construction Activities

Examples of pre-construction activities include, but are not limited to, bond approval, permits, pre-construction submittals and approvals. Include pre-construction activities that are required to be completed prior to the Contractor starting the demolition or construction stage of work.

1.10.1.5.2 Procurement Activities

Examples of procurement activities include, but are not limited to: Material/equipment submittal preparation, submittal and approval of material/equipment; material/equipment fabrication and delivery, and material/equipment on-site. As a minimum, separate procurement activities must be provided for critical items, long lead items, items requiring Government approval and material/equipment procurement for which payment will be requested in advance of installation. Show each delivery with relationship tie to the Construction Activity specifically for the delivery.

1.10.1.5.3 Government Activities

Government and other agency activities that could impact progress must be clearly identified. Government activities include, but are not limited to; Government approved submittal reviews, Government conducted inspections/tests, environmental permit approvals by State regulators, utility outages, and delivery of Government Furnished Material/Equipment.

1.10.1.5.4 Construction Quality Management (CQM) Activities

The Preparatory and Initial Phase meetings for each Definable Feature of Work identified in the Contractor's Quality Control Plan must be included in the Three-Week Look Ahead Schedule. Preparatory and Initial phase meetings are not required in the NAS, but can be represented by a start milestone linked to successor parent Construction Activity. The Follow-up Phase must be represented by the Construction Activities themselves in the NAS.

1.10.1.5.5 Construction Activities

On-site construction activities must not have a duration in excess of 20 working days. Contractor activities must be driven by calendars that reflect Saturdays, Sundays and all Federal Holidays as non-work days, unless otherwise defined in this contract.

1.10.1.5.6 Turnover and Closeout Activities

Include activities or milestones for items on the NAVFAC Red Zone Checklist/POAM that are applicable to this project. As a minimum, include required Contractor testing, required Government acceptance inspections on equipment, Pre-Final Inspection, Punch List Completion, Final Inspection and Acceptance. Add an unconstrained start milestone for the initial NAVFAC Red Zone - Facility Turnover Planning Meeting at approximately 75 percent construction contract completion or six months prior to Contract Completion Date (CCD), whichever is sooner.

1.10.1.5.7 Testing of HVAC - DALT, TAB, and PVT Activities

Include in the baseline schedule, activities and milestones associated with Government acceptance of Duct Air Leakage Test (DALT), Testing, Adjusting, and Balancing (TAB) and Performance Verification Test (PVT) as required and in accordance with Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC and Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

- a. Identify the general area or location(s) for Government Acceptance Testing of DALT, TAB and PVT.
- b. Incorporate into the baseline schedule, time periods required for advance notification of work, and Government submittal review in accordance with Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC, paragraph DALT AND TAB SUBMITTAL AND WORK SCHEDULE.
- c. Include the following as schedule activities or milestones:
 - (1) Pre-DALT/TAB/PVT Meeting
 - (2) TAB Design Review Report, Government review
 - (3) TAB Pre-Field Engineering Report, Government review
 - (4) DALT Field Work
 - (5) DALT Field Acceptance Testing
 - (6) Certified Final DALT Report, Government review
 - (7) Control Contractors PVT Plan, Government review
 - (8) Equipment Suppliers PVT Plan, Government review
 - (9) Season I TAB Field Work
 - (10) Season I Certified Final TAB Report, Government review
 - (11) Endurance Testing, Government review
 - (12) PVT Field Work
 - (13) PVT Report, Government review
 - (14) Season I TAB Field Acceptance Testing
 - (15) Season II TAB Field Work

(16) Season II Certified Final TAB Report, Government review

(17) Season II TAB Field Acceptance Testing

(18) Post-Occupancy Endurance Testing Government review

(19) Post-Occupancy PVT Field Work

1.10.1.5.8 Commissioning Activities

Include in the baseline schedule activities and milestones associated with Commissioning.

- a. Identify the general area or location(s) of systems for Commissioning Inspection and Testing
- b. Incorporate into the baseline schedule time periods for Government submittal review

1.10.1.6 Contract Milestones and Constraints

1.10.1.6.1 Project Start Date Milestones

Include as the first activity on the schedule a start milestone titled, "Contract Award", which must have a Mandatory Start constraint equal to the Contract Award Date.

1.10.1.6.2 Pre-Construction Meeting Milestone

Include an unconstrained finish milestone on the schedule titled, "Pre-Construction Meeting". The Pre-Construction meeting may be a single day, or it may range over several days. The intent to cover all the Pre-Con topics, including Partnering and DD1354.

1.10.1.6.3 Preconstruction Submittals Finish Milestone

Include an unconstrained finish milestone on the schedule titled, "Preconstruction Submittals". This milestone is complete when all required preconstruction submittals have been reviewed and approved by the Government.

1.10.1.6.4 Contractor Mobilization Finish Milestone

Include an unconstrained finish milestone on the schedule titled, "Contractor Mobilization".

1.10.1.6.5 NAVFAC Red Zone - Facility Turnover Planning Meeting Milestones

See paragraph TURNOVER AND CLOSEOUT ACTIVITIES above.

1.10.1.6.6 Substantial Completion Milestone

Include an unconstrained finish milestone on the schedule titled "Substantial Completion." Substantial Completion is defined as the point in time the Government would consider the project ready for beneficial occupancy wherein by mutual agreement of the Government and Contractor, Government use of the facility is allowed while construction access continues in order to complete remaining items (e.g. punch list and other

close out submittals). Include a separate Substantial Completion Milestone for each phase if the contract requires construction to be completed in phases.

1.10.1.6.7 DD-1354 Finish Milestone

Add unconstrained finish milestone, titled "DD-1354" and scheduled 30 calendar days prior to Substantial Completion, whenever a Form DD-1354 is required in accordance with Section 01 20 00 PRICE AND PAYMENT PROCEDURES.

1.10.1.6.8 Projected Completion Milestone

Include an unconstrained finish milestone on the schedule titled "Projected Completion." Projected Completion is defined as the point in time all contract requirements are complete and verified by the Government with a successful Final Inspection in accordance with Section 01 45 00.00 20 QUALITY CONTROL. This milestone must have the Contract Completion Date (CCD) milestone as its only successor.

1.10.1.6.9 Contract Completion Date (CCD) Milestone

Last schedule entry must be an unconstrained finish milestone titled "Contract Completion (CCD: DD-MM-YY)." DD-MM-YYYY is the current contract completion date at data date, day-month-year corresponding to P6 Must Finish By Date. NAS milestone updates of Project Completion finish date for longest path must reflect calculated float as positive or negative based on CCD. Calculation of schedule updates must be such that if the finish of the "Projected Completion" milestone falls after the contract completion date, then negative float is calculated on the longest path. If the finish of the "Projected Completion" milestone falls before the contract completion date, the float calculation must reflect positive float on the longest path.

1.10.1.6.10 Additional Milestones

Provide up to 5 additional milestones as required by Contracting Officer.

1.10.1.7 Work Breakdown Structure & Activity Code

At a minimum, establish a Work Breakdown Structure (WBS) and provide activity codes identified as follows:

1.10.1.7.1 Work Breakdown Structure (WBS)

Group all activities and milestones within appropriate WBS categories including, at a minimum, the following:

a. Project Milestones:

- (1) Management Milestones
- (2) Project Administrative Meetings
- (3) Permits

b. Pre-Construction Phase:

- (1) Submittals and Reviews

- (2) Procurement
 - (3) Mobilization
 - c. Construction Phase: Create multiple sub-sections in accordance with project specific categories of work including in WBS descending order as follows:
 - (1) General Area
 - (a) Type of Work Item
 - 1. Location
 - d. Commissioning & Testing:
 - (1) Specific area/locations of commissioning
 - (2) Final Testing
 - (3) Training
 - di. Project Closeout: Include activity items such as, but not limited to, Punchlist, Demobilization, O&M, As-built Drawings, Training, and As-built NAS.
 - dii. Modifications: Create sub-category of Conformed and Non-Conformed under Modification WBS. Create multiple sub-sections as the project progresses identified by issue and Fragnet placed in Conformed for modifications issued prior data date, or Non-Conformed for issues not modified to contract prior data date.
 - diii. Removed Activity: Activity is "removed" by remaining within logic sequence, eliminating duration and adding "(NO LONGER REQUIRED)" after Activity Name in Activity Table.
- 1.10.1.7.2 Responsibility Code
- All activities in the project schedule must be identified with the resource for completing the task. Activities must not belong to more than one responsible party.
- 1.10.1.7.3 Activity Category Code
- Provide user defined "CAT" codes for Project Level activity codes. Use the following codes:
- a. Assign "PROC" value to Procurement type activity
 - b. Assign "PRE-CON" value to Pre-construction activity
 - c. Assign "CONS" value to Construction type activity
 - d. Assign "TEST" value to dedicated testing type activities
 - e. Assign "CX" value to dedicated Commissioning type activities
 - f. Assign "CLOS" value to dedicated Close Out type activity

g. Assign "OTHR" to other activity not otherwise designated

1.10.1.7.4 Construction Specification Institute (CSI) Masterformat Code

Provide up to an additional five activity codes as required by the Contracting Officer.

1.10.1.7.5 Drawing Code

Identify all activities in the project schedule with its respective Drawing Code. The Drawing Code is the Sheet Number on the primary project drawing which indicates work to be performed. If an activity does not have an applicable Drawing Code (e.g. Mobilize), the code must be "0000".

1.10.1.8 Adverse Weather Lost Work Days

Use the National Oceanic and Atmospheric Administration's (NOAA) Summary of Monthly Normals report to obtain the historical average number of days each month with precipitation, using a nominal 30-year, greater than 0.10 inch precipitation amount parameter, as indicated on the Station Report for the NOAA location closest to the project site as the basis for establishing a "Weather Calendar" showing the number of anticipated non-workdays for each month due to adverse weather, in addition to Saturdays, Sundays and all Federal Holidays as non-work days.

1.10.1.9 Anticipated Restricted Delays

Unless otherwise noted or defined in Section 01 14 00 WORK RESTRICTIONS, allow in the schedule one lost workday for every two months of project duration for instances where base access is not permitted or where work areas are temporarily not accessible for security reasons which causes a delay in the work. Use Anticipated Restricted Delays as basis for establishing a "Security Calendar" showing the number of anticipated non-workdays for each month due to anticipated restrictions, in addition to anticipated adverse weather, Saturdays, Sundays and all Federal Holidays as non-work days. Assign the Security Calendar to any activity that could be impacted by restriction delays. The Contracting Officer will issue a modification in accordance with the contract clauses, giving the Contractor a time extension for the difference of days between the anticipated and actual lost work days if the number of actual restriction delay days exceeds the number of anticipated for the month in which the delay occurs and the restriction delayed activities are critical to contract completion. A lost workday due to restriction delay is defined as a day in which the Contractor cannot work at least 50 percent of the day on the impacted activity.

Impacts resulting from restriction delays must be documented in Narrative Report for the month that it occurred.

Make changes to P6 project calendars to reflect as-built conditions where work occurred where originally anticipated as non-work days, and where work did not occur (lost work day).

1.10.1.10 Cost Loading

The Project Network Analysis Schedule (NAS) must be cost-loaded and will provide the basis for progress payments. Earned Value Reports must be derived from and correspond to cost loaded NAS. Use the Critical Path Method (CPM) and the Precedence Diagram Method (PDM) to satisfy time and

cost applications.

1.10.1.10.1 Cost Loading Activities

Assign material and equipment costs, including their quantities, for which payment will be requested in advance of installation, to their respective procurement activity. Assign labor costs, including their quantities, for material and equipment paid for after installation to their respective construction activities. Include all typical mobilization costs dispersed over early construction activities. Costs for mobilization will not be paid as individual pay items with the exception of batch plant set-up, mobilization of dredging equipment or other similar labor-intensive situations. The value of commissioning, testing and closeout WBS section may not be less than 10 percent of the total costs for procurement and construction activities. ALL activities assigned Government responsibility will have Zero Cost. No contractor cost should be assigned to an activity designated as a Government responsibility. Do not include field overhead positions as individual pay items. Evenly disperse overhead costs and profit to each activity over the duration of the project.

1.10.1.10.2 Partial Payment

Breakdown unit of measure and cost must be defined within P6 Activity Detail Expenses for partial payment of any cost loaded activity. Lump sum cost loaded activity will not be partially paid.

1.10.2 Schedule Software Settings and Restrictions

- a. Activity Constraints: Date/time constraint(s), other than those required by the contract, are not allowed unless accepted by the Contracting Officer. Identify any constraints proposed and provide an explanation for the purpose of the constraint in the Narrative Report as described in paragraph REQUIRED TABULAR REPORTS.
- b. Default Progress Data Disallowed: Actual Start is date work begins on activity with intent to pursue work to substantial completion. Actual Finish is date work is substantially complete to point where successor activity can begin. Actual dates on the CPM schedule must correspond with activity dates reported on the Contractor Quality Control and Production Reports.
- c. At a minimum, include the following settings and parameters in P6 Schedule preparation:
 - (1) General: Define or establish Calendars and Activity Codes at the "Project" level, not the "Global" level.
 - (2) Admin Drop-Down Menu, Admin Preferences, Time Periods Tab:
 - (a) Set time periods for P6 to 8.0 Hours/Day, 40.0 Hours/Week, 172.0 Hours/Month and 2000.0 Hours/Year.
 - (b) Use assigned calendar to specify the number of work hours for each time period: Must be checked.
 - (3) Admin Drop-Down Menu, Admin Preferences, Earned Value Tab:
 - (a) Earned Value Calculation: Use "Budgeted values with current

dates".

(4) Project Level, Dates Tab:

(a) Set "Must Finish By" date to "Contract Completion Date", and set "Must Finish By" time to 05:00pm.

(5) Project Level, Defaults Tab:

(a) Duration Type: Set to "Fixed Duration & Units".

(b) Percent Complete Type: Set to "Physical".

(c) Activity Type: Set to "Task Dependent".

(d) Calendar: Set to "Standard 5 Day Workweek". Calendar must reflect Saturday, Sunday and all Federal holidays as non-work days. Alternative calendars may be used with Contracting Officer approval.

(6) Project Level, Calculations Tab:

(a) Default Price/Unit for activities without resource or role Price/Units: Set to "\$1/h".

(b) Activity percent complete based on activity steps: Must be Checked.

(c) Link Budget and At Completion for not started activities: Must be Checked.

(d) Reset Remaining Duration and Units to Original: Must be Selected.

(e) Subtract Actual from At Completion: Must be Selected.

(f) Recalculate Actual units and Cost when duration percent complete changes: Must be Checked.

(g) Update units when costs change on resource assignments: Must be Unchecked.

(h) Link Actual to Date and Actual This Period Units and Cost: Must be Checked.

(7) Project Level, Settings Tab:

(a) Define Critical Activities: Check "Longest Path".

(8) Work Breakdown Structure Level, Earned Value Tab:

(a) Technique for Computing Performance Percent Complete: "Activity percent complete" is selected.

(b) Technique for Computing Estimate to Complete (ETC): "PF = 1" is selected.

1.10.3 Required Tabular Reports and Native P6 XER Files

Include the following reports with the Baseline, Monthly Update and any other required schedule submittals:

a. Time Scaled Logic Schedule

Provide formatted 11 by 17-inch Time-scaled Logic Schedule in color and landscape-oriented with each schedule submittal. Clearly show activities on the longest path setting Gantt chart longest path activity bars to red. Group activities by WBS and sort by finish date in ascending order. Include the following information in column form for each activity and include accompanying Gantt chart:

- (1) Activity ID
- (2) Activity Name
- (3) Original Duration
- (4) Remaining duration
- (5) Physical Percent Complete
- (6) Start Date
- (7) Finish Date
- (8) Total Float

b. Previous Monthly Update Comparison Time Scaled Logic Schedule (Submit with all Monthly Update Schedule Submittals.)

Provide formatted 11 by 17-inch Time-scaled Logic Schedule in color and landscape-oriented with each monthly update schedule submittal. Clearly show activities on the current month longest path setting Gantt chart longest path activities bars to red. Show previous month activities as yellow bars and previous month milestones in yellow within Gantt chart. Sort by finish date in ascending order. Filter activities for longest path. Maintain and assign the accepted previous month update or the accepted baseline schedule for the first update submittal as the baseline and primary baseline in P6 before printing the schedule. Include the following information in column form for each activity and include accompanying Gantt chart:

- (1) Activity ID
- (2) Activity Name
- (3) Original Duration
- (4) Current Month Remaining Duration
- (5) Current Month Start Date
- (6) Previous Month Update Start Date (BL Project Start)
- (7) Start Date Delta between Current Month and Previous Month
(Variance - BL Project Start Date)

- (8) Current Month Finish Date
- (9) Previous Month Finish Date (BL Project Finish)
- (10) Finish Date Delta between Current Month and Previous Month
(Variance - BL Project Start Date)
- (11) Current Month Total Float
- c. P6 native XER file: Include the back-up native .xer program file compatible with the Government version of P6. Each native schedule file must have a unique file name to include project name and data date using (yyyy-mm-dd) convention. Each native schedule must have a unique Project ID and Project Name.
- d. Log Report: P6 Scheduling/Leveling Report.
- e. Narrative Report: Identify and justify:
 - (1) Provide Project Summary Data in format below:
 - (a) Data Date _____
 - (b) Award Date: _____
 - (c) Original Project Duration: _____ days post Award Date
 - (d) Current Project Duration: _____ days post Award Date
 - (e) Time percent elapsed: _____ percent at data date
 - (f) Original CCD: _____
 - (g) Current CCD: _____ (thru MOD _____)
 - (h) Anticipated CCD: _____ (____ calendar days early/late)
 - (i) Original Contract Value: \$_____
 - (j) Current Contract Value: \$_____
 - (k) Invoiced Amount: \$_____ (____ percent)
 - (l) Cost Growth: _____ percent
 - (m) Schedule Growth: _____ percent
 - (n) There are a total of _____ activities, _____ activities complete (____ percent), _____ activities in progress (____ percent), _____ activities not started (____ percent). Of the in progress and not started activities; _____ (____ percent) are on the longest path. The longest path has duration of _____ calendar days from data-date to anticipated project completion.
 - (2) Progress made in each area of the project;
 - (3) Longest Path;

- (4) Date/time constraint(s), other than those required by the contract
- (5) Listing of all changes made between the previous schedule and current updated schedule include: added or deleted activities, original and remaining durations for activities that have not started, logic (sequence constraint lag/lead), milestones, planned sequence of operations, longest path, calendars or calendar assignments, and cost loading;
- (6) Any decrease in previously reported activity Earned Amount;
- (7) Pending items and status thereof, including permits, changes orders, and time extensions;
- (8) Status of Contract Completion Date and interim milestones;
- (9) Status of Projected Completion Milestone and account of difference in calendar days between previous update Projected Completion Milestone
- (10) Current and anticipated delays listing Activity Names and IDs for impacted activities(describe cause of delay and corrective actions(s) and mitigation measures to minimize);
- (11) Description of current and potential future schedule problem areas.
- (12) Identification of any weather and restricted lost time as compared to anticipated weather for the month and anticipated restricted days for which the update is submitted. Impacts resulting from adverse weather must be documented in tabular form showing the calendar month (or billing period) with the days on which construction activity incurred Lost Work Days due to adverse weather. In narrative form, describe the adverse weather cause such as precipitation measurement, temperature, wind or other influencing factors, and why work was impacted. Describe the construction activity(s) that was (were) scheduled, impacted.

Each entry in the narrative report must cite the respective Activity ID and Activity Name, the date and reason for the change, and description of the change.

- f. Earned Value Report: Derive from and correspond to P6 cost loaded schedule. List all activities having a budget amount cost loaded. Compile total earnings on the project from notice to proceed to current progress payment request. Show current budget, previous physical percent complete, to-date physical percent complete, previous earned value, to-date earned value, cost this period and cost to complete on the report for each activity.
- g. Schedule Variance Control (SVC) Diagram: With each schedule submission, provide a SVC diagram showing 1) A Cash Flow Curve indicating planned project cost based on each of projected early and projected late activity finish dates and 2) one curve for Earned Value to-date. Revise Cash Flow Curves when the contract is modified, or as directed by the Contracting Officer Include a legend on report clearly indication 3 curves: early finish, late finish, and earned-value to date.

Use the following settings in Activity Usage Profile Options:

- (1) In the Data section, under Display, the radio box for Cost must be selected.
- (2) In the Data section, under Filter for Bars/Graphs, the checkbox for Total must be checked.
- (3) In the Show Bars/Curves section:
 - (a) Under the By Date column, the checkboxes for Baseline, Actual and Remaining Late must be checked. The checkboxes for Budgeted and Remaining Early must be unchecked.
 - (b) Under the Cumulative column, the checkboxes for Baseline, Actual and Remaining Late must be checked. The checkboxes for Budgeted and Remaining Early must be unchecked.
 - (c) Set the color for Baseline to green.
 - (d) Set the color for Actual to blue.
 - (e) Set the color for Remaining Late to red.
- (4) In the Show Earned Value Curves section, the checkboxes for Planned Value Cost, Earned Value Cost and Estimate at Completion must be unchecked.
- h. Logic Diagram showing timescale from data date to 60 days after data date with filter for longest path. Leave Group By selection blank and sort by finish date in ascending order.
- i. Baseline or Monthly Update Checklist as applicable completed and certified by Qualified Scheduler. Baseline Project Schedule and Monthly Update Schedule Checklists can be found on the Whole Building Design Guide website at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-01-32-17-00-20>
- j. Screen shot PDF of P6 Time Periods Settings referenced in paragraph SCHEDULE SOFTWARE SETTINGS AND RESTRICTIONS, list item d.(2): ADMIN DROP-DOWN MENU, ADMIN PREFERENCES, TIME PERIODS TAB
- k. Daily Reported Production Activity: Submit on a monthly basis, in electronic spreadsheet (format provided by the Government), summary of daily reported production activity for the reporting month in the update schedule. Use the following columns for reporting:
 - (1) Date
 - (2) Activity ID
 - (3) Work Description
 - (4) Contractor
 - (5) Billable Hours
- l. HVAC/COMMISSIONING KTR Checklist. See Section 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC for checklist requirements. Complete checklist listing all items with baseline submittal. Complete checklist as required to complete project, submitting complete checklist in intermediately following monthly update submittal.

1.11 CONTRACT MODIFICATION

1.11.1 Time Impact Analysis (TIA)

Submit a Time Impact Analysis with each cost and time proposal for a proposed change. TIA must illustrate the influence of each change or delay on the Contract Completion Date or milestones. No time extensions will be granted nor delay damages paid unless a delay occurs which consumes all available Project Float, impacts the longest path, and extends the Projected Completion beyond the Contract Completion Date.

- a. Each TIA must be in both narrative and schedule form. The narrative must define the scope and conditions of the change; provide start and finish dates of impact, successor and predecessor activity to impact period, responsible party; describe how it originated, and how it impacts the schedule's longest path. The schedule submission must consist of three native XER files:
 - (1) Fragnet used to define the scope of the changed condition
 - (2) Most recent accepted schedule update as of the time of the impact start date. Update this schedule to show all activity progress as of the time of the impact start date. The impact start date is identified as the time when an existing activity is impeded for either starting or finishing.
 - (3) The impacted schedule that has the fragnet inserted in the updated schedule and the schedule "run" so that the new completion date is determined.
- b. For claimed as-built project delay, the inserted fragnet TIA method must be modified to account for as-built events known to occur after the data date of schedule update used. Updated schedules for periods following the impact start date will be used to evaluate how the project progressed (as-built) through the finish of impact. Impact to longest path must be determined for each following update period.
- c. All TIAs must include any mitigation, and must determine the apportionment of the overall delay assignable to each individual delay. Apportionment must provide identification of delay type and classification of delay by compensable and non-compensable events. The associated narrative must clearly describe analysis methodology used, and the findings in a chronological listing beginning with the earliest delay event.
 - (1) Identify and classify types of delay defined as follows:
 - (a) Force majeure delay (e.g. weather delay): Any delay event caused by something or someone other than the Government or the Contractor, or the risk of which has not been assigned solely to the Government or the Contractor. If the force majeure delay is on the longest path, in absence of other types of concurrent delays, the Contractor is granted an extension of contract time,

classified as a non-compensable event.

(b) A Contractor-delay: Any delay event caused by the Contractor, or the risk of which has been assigned solely to the Contractor. If the contractor-delay is on the longest path, in absence of other types of concurrent delays, Contractor is not granted extension of contract time, and classified as a non-compensable event. Where absent other types of delays, and having impact to project completion, Contractor must provide to Contracting Officer a Corrective Action Plan identifying plan to mitigate delay.

(c) A Government-delay: Any delay event caused by the Government, or the risk of which has been assigned solely to the Government. If the Government-delay is on the longest path, in absence of other types of concurrent delays, the Contractor is granted an extension of contract time, and classified as a compensable event.

- (2) Functional concurrency must be used to analyze concurrent delays, where: separate delay issues delay project completion, do not necessarily occur at same time, rather occur within same monthly schedule update period at minimum, or within same as-built period under review. If a combination of functionally concurrent delay types occurs, it is considered Concurrent Delay, which is defined in the following combinations:

(a) Government-delay concurrent with contractor-delay: excusable time extension, classified non-compensable event.

(b) Government-delay concurrent with force majeure delay: excusable time extension, classified non-compensable event.

(c) Contractor-delay concurrent with force majeure delay: excusable time extension, classified non-compensable event.

- (3) Pacing delay reacting to another delay (parent delay) equally or more critical than paced activity must be identified prior to pacing. Contracting Officer will notify Contractor prior to pacing. Contractor must notify Contracting Officer prior to pacing. Notification must include identification of parent delay issue, estimated parent delay time period, paced activity(s) identity, and pacing reason(s). Pacing Concurrency is defined as follows:

(a) Government-delay concurrent with contractor-pacing: excusable time extension, classified compensable event.

(b) Contractor-delay concurrent with Government-pacing: inexcusable time extension, classified non-compensable event

- d. Submit electronic file containing the narrative and the source schedule files used in the time impact analysis.

1.12 PROJECT FLOAT

Project Float is the length of time between the Contractor's Projected Completion Milestone and the Contract Completion Date. Project Float available in the schedule will not be for the exclusive use of either the Government or the Contractor.

The use of Resource Leveling or other techniques used for the purpose of artificially adjusting activity durations to consume float and influence longest path is prohibited.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES

08/18, CHG 4: 02/21

PART 1 GENERAL

1.1 SUMMARY

1.2 DEFINITIONS

1.2.1 Submittal Descriptions (SD)

Submittal requirements are specified in the technical sections. Examples and descriptions of submittals identified by the Submittal Description (SD) numbers and titles follow:

SD-01 Preconstruction Submittals

Submittals that are required prior to or commencing with the start of work on site. Submittals that are required prior to or at the start of construction (work) or the next major phase of the construction on a multiphase contract. Preconstruction Submittals include schedules and a tabular list of locations, features, and other pertinent information regarding products, materials, equipment, or components to be used in the work.

Certificates Of Insurance

Surety Bonds

List Of Proposed Subcontractors

List Of Proposed Products

Baseline Network Analysis Schedule (NAS)

Submittal Register

Earned Value Report

Accident Prevention Plan Health And Safety Plan

Work Plan

Quality Control (QC) plan

Environmental Protection Plan

SD-02

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards ensuring work can be judged. Includes assemblies or portions of assemblies that are to be incorporated into the project and those that will be removed at conclusion of the work.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. Unless specified in another section, testing must have been within three years of date of contract award for the project.

Report that includes findings of a test required to be performed on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report that includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports

Daily logs and checklists

Final acceptance test and operational test procedure

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that the product, system, or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor. The document purpose is to further promote the orderly progression of a portion of the work by documenting procedures, acceptability of methods, or personnel qualifications.

Confined space entry permits

Text of posted operating instructions

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (SDS) concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data provided by the manufacturer, or the system provider, including manufacturer's help and product line documentation, necessary to maintain and install equipment, for operating and maintenance use by facility personnel.

Data required by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

Data incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Submittals required for Guiding Principle Validation (GPV) or Third Party Certification (TPC).

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase

of construction on a multi-phase contract.

1.2.2 Approving Authority

Office or designated person authorized to approve the submittal.

1.2.3 Work

As used in this section, on-site and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction. In exception, excludes work to produce SD-01 submittals.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submittal Register; G

1.4 SUBMITTAL CLASSIFICATION

1.4.1 Government Approved (G)

Within the terms of the Contract Clause SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION, submittals are considered to be "shop drawings."

1.4.2 For Information Only

Submittals not requiring Government approval will be for information only. Within the terms of the Contract Clause SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION, they are not considered to be "shop drawings."

1.4.3 Sustainability Reporting Submittals (S)

Submittals for Guiding Principle Validation (GPV) or Third Party Certification (TPC) are indicated with an "S" designation. These submittals are for information only and for use as specified in Section 01 33 29 SUSTAINABILITY REPORTING.

Schedule submittals for these items throughout the course of construction as provided; do not wait until closeout.

1.5 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

As soon as practicable after award of contract, and before procurement or fabrication, forward to the Architect-Engineer: Moffatt & Nichol + Burns & McDonnell Joint Venture (MN+BMCD), submittals required in the technical sections of this specification, including shop drawings, product data and samples. In addition, forward a copy of the submittals to the Contracting Officer.

1.5.1 O&M Data

Submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

In the event the Contractor fails to deliver O&M data within the time limits specified, the Contracting Officer may withhold from progress payments 50 percent of the price of the items to which such O&M data apply.

1.5.2 Submittals Reserved for NAVFAC Midlant Approval

As an exception to the standard submittal procedure for Government Approval, submit the following to the Commander, NAVFAC Midlant, Code:

- a. Section 31 62 16.13, 31 62 16.16, 35 59 20: Pile driving records
- b. Section 21 12 00, 21 13 13, 21 22 00.00 40, 21 30 00: All fire protection system submittals
- c. Section 28 31 76: All fire alarm system submittals
- d. Section 14 24 23: All elevator submittals
- e. Section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING: SD-06 Commissioning Plan, Certificate of Readiness, and Commissioning Report submittals
- f. Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC: SD-06 field test report submittals
- g. Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC: All submittals
- h. Section 26 12 19.10 THREE-PHASE PAD-MOUNTED TRANSFORMERS: All submittals
- i. Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION: Transformer submittals
- j. Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP): Wire and Cable Submittals
- k. Section 26 11 16 SECONDARY UNIT SUBSTATIONS: Transformer submittals

1.6 PREPARATION

1.6.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels to the office of the approving authority using the transmittal form prescribed by the Contracting Officer. Include all information prescribed by the transmittal form and required in paragraph IDENTIFYING SUBMITTALS. Use the submittal transmittal forms to record actions regarding samples.

Use the ENG Form 4025-R transmittal form for submitting both Government-approved and information-only submittals. Submit in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor. Properly complete this form by filling

out all the heading blank spaces and identifying each item submitted. Exercise special care to ensure proper listing of the specification paragraph and sheet number of the contract drawings pertinent to the data submitted for each item.

1.6.2 Identifying Submittals

The Contractor's Quality Control Manager must prepare, review and stamp submittals, including those provided by a subcontractor, before submittal to the Government.

Identify submittals, except sample installations and sample panels, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

- a. Project title and location
- b. Construction contract number
- c. Dates of the drawings and revisions
- d. Name, address, and telephone number of Subcontractor, supplier, manufacturer, and any other Subcontractor associated with the submittal.
- e. Section number of the specification by which submittal is required
- f. Submittal description (SD) number of each component of submittal
- g. For a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission
- h. Product identification and location in project.

1.6.3 Transmittal Assembly Requirements:

In order to provide reviewers with a complete submittal package for review transmittals must include all SD items under a given SD heading and must not be broken up into separate transmittals unless a variation is being requested. It is preferred that shop drawings (SD-02), product data (SD-03), Design Data (SD-05), Certificates (SD-07), and Manufacturer's Instructions (SD-08) be submitted at the same time and under one transmittal but, breaking these individual SD items up into separate submittals is prohibited.

1.6.4 Submittal Format

1.6.4.1 Format of SD-01 Preconstruction Submittals

When the submittal includes a document that is to be used in the project, or is to become part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document itself, but to a separate sheet accompanying the document.

Provide data in the unit of measure used in the contract documents.

1.6.4.2 Format for SD-02 Shop Drawings

Provide shop drawings not less than 8 1/2 by 11 inches nor more than 30 by 42 inches, except for full-size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless another form is required. Ensure drawings are suitable for reproduction and of a quality to produce clear, distinct lines and letters, with dark lines on a white background.

- a. Include the nameplate data, size, and capacity on drawings. Also include applicable federal, military, industry, and technical society publication references.
- b. Dimension drawings, except diagrams and schematic drawings. Prepare drawings demonstrating interface with other trades to scale. Use the same unit of measure for shop drawings as indicated on the contract drawings. Identify materials and products for work shown.

Present shop drawings sized 8 1/2 by 11 inches as part of the bound volume for submittals. Present larger drawings in sets. Submit an electronic copy of drawings in PDF format.

1.6.4.2.1 Drawing Identification

Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph IDENTIFYING SUBMITTALS.

Number drawings in a logical sequence. Each drawing is to bear the number of the submittal in a uniform location next to the title block. Place the Government contract number in the margin, immediately below the title block, for each drawing.

Reserve a blank space, no smaller than 4 inches on the right-hand side of each sheet for the Government disposition stamp.

1.6.4.3 Format of SD-03 Product Data

Present product data submittals for each section as a complete, bound volume. Include a table of contents, listing the page and catalog item numbers for product data.

Indicate, by prominent notation, each product that is being submitted; indicate the specification section number and paragraph number to which it pertains.

1.6.4.3.1 Product Information

Supplement product data with material prepared for the project to satisfy the submittal requirements where product data does not exist. Identify this material as developed specifically for the project, with information and format as required for submission of SD-07 Certificates.

Provide product data in units used in the Contract documents. Where product data are included in preprinted catalogs with another unit, submit the dimensions in contract document units, on a separate sheet.

1.6.4.3.2 Standards

Where equipment or materials are specified to conform to industry or

technical-society reference standards of such organizations as the American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), or Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.6.4.3.3 Data Submission

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal that is marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will not be accepted for expedition of the construction effort.

Submit the manufacturer's instructions before installation.

1.6.4.4 Format of SD-04 Samples

1.6.4.4.1 Sample Characteristics

If finish samples are from the same product, color, and manufacturer as the basis of design product, a sample is not needed.

Furnish samples in the following sizes, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately the same size as specified:

- a. Sample of Equipment or Device: Full size.
- b. Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.
- c. Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.
- d. Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.
- e. Sample Volume of Nonsolid Materials: Pint. Examples of nonsolid materials are sand and paint.
- f. Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.
- g. Sample Panel: 4 by 4 feet.
- h. Sample Installation: 100 square feet.

1.6.4.4.2 Sample Incorporation

Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples are to be in undamaged condition at the time of use.

Recording of Sample Installation: Note and preserve the notation of any area constituting a sample installation, but remove the notation at the final clean-up of the project.

1.6.4.4.3 Comparison Sample

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

When color, texture, or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.6.4.5 Format of SD-05 Design Data

Provide design data and certificates on 8 1/2 by 11 inch paper. Provide a bound volume for submittals containing numerous pages.

1.6.4.6 Format of SD-06 Test Reports

Provide reports on 8 1/2 by 11 inch paper in a complete bound volume.

By prominent notation, indicate each report in the submittal. Indicate the specification number and paragraph number to which each report pertains.

1.6.4.7 Format of SD-07 Certificates

Provide design data and certificates on 8 1/2 by 11 inch paper. Provide a bound volume for submittals containing numerous pages.

1.6.4.8 Format of SD-08 Manufacturer's Instructions

Present manufacturer's instructions submittals for each section as a complete, bound volume. Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal, military, industry, and technical-society publication references. If supplemental information is needed to clarify the manufacturer's data, submit it as specified for SD-07 Certificates.

Submit the manufacturer's instructions before installation.

1.6.4.8.1 Standards

Where equipment or materials are specified to conform to industry or technical-society reference standards of such organizations as the American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), or Association of Edison Illuminating Companies (AEIC),

submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.6.4.9 Format of SD-09 Manufacturer's Field Reports

Provide reports on 8 1/2 by 11 inch paper in a complete bound volume.

By prominent notation, indicate each report in the submittal. Indicate the specification number and paragraph number to which each report pertains.

1.6.4.10 Format of SD-10 Operation and Maintenance Data (O&M)

Comply with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA for O&M Data format.

1.6.4.11 Format of SD-11 Closeout Submittals

When the submittal includes a document that is to be used in the project or is to become part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document itself, but to a separate sheet accompanying the document.

Provide data in the unit of measure used in the contract documents.

1.6.5 Source Drawings for Shop Drawings

1.6.5.1 Source Drawings

The entire set of source drawing files (DWG) will not be provided to the Contractor. Request the specific Drawing Number for the preparation of shop drawings. Only those drawings requested to prepare shop drawings will be provided. These drawings are provided only after award.

1.6.5.2 Terms and Conditions

Data contained on these electronic files must not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse is at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor must make no claim, and waives to the fullest extent permitted by law any claim or cause of action of any nature against the Government, its agents, or its subconsultants that may arise out of or in connection with the use of these electronic files. The Contractor must, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities, or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic source drawing files are not construction documents. Differences may exist between the source drawing files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic

source drawing files, nor does it make representation to the compatibility of these files with the Contractor hardware or software. The Contractor is responsible for determining if any conflict exists. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished source drawing files, the signed and sealed construction documents govern. Use of these source drawing files does not relieve the Contractor of the duty to fully comply with the contract documents, including and without limitation the need to check, confirm and coordinate the work of all contractors for the project. If the Contractor uses, duplicates or modifies these electronic source drawing files for use in producing construction data related to this contract, remove all previous indication of ownership (seals, logos, signatures, initials and dates).

1.6.6 Electronic File Format

Provide submittals in electronic format, with the exception of material samples required for SD-04 Samples items. Compile the submittal file as a single, complete document, to include the Transmittal Form described within. Name the electronic submittal file specifically according to its contents, and coordinate the file naming convention with the Contracting Officer. Electronic files must be of sufficient quality that all information is legible. Use PDF as the electronic format, unless otherwise specified or directed by the Contracting Officer. Generate PDF files from original documents with bookmarks so that the text included in the PDF file is searchable and can be copied. If documents are scanned, optical character resolution (OCR) routines are required. Index and bookmark files exceeding 30 pages to allow efficient navigation of the file. When required, the electronic file must include a valid electronic signature or a scan of a signature.

E-mail electronic submittal documents smaller than 10MB to an e-mail address as directed by the Contracting Officer. Provide electronic documents over 10 MB on an optical disc or through an electronic file sharing system such as the AMRDEC SAFE Web Application located at the following website: <https://safe.amrdec.army.mil/safe/>.

1.7 QUANTITY OF SUBMITTALS

1.7.1 Number of SD-01 Preconstruction Submittal Copies

Unless otherwise specified, submit two sets of administrative submittals.

1.7.2 Number of SD-04 Samples

- a. Submit one sample, or one sets of samples showing the range of variation, of each required item.
- b. Submit one sample panel or provide one sample installation where directed. Include components listed in the technical section or as directed.
- c. Submit one sample installation, where directed.
- d. Submit one sample of nonsolid materials.

1.7.3 Number of SD-05 Design Data Copies

Submit in compliance with quantity requirements specified for shop

drawings.

1.7.4 Number of SD-06 Test Report Copies

Submit in compliance with quantity and quality requirements specified for shop drawings, other than field test results that will be submitted with QC reports.

1.7.5 Number of SD-07 Certificate Copies

Submit in compliance with quantity requirements specified for shop drawings.

1.7.6 Number of SD-08 Manufacturer's Instructions Copies

Submit in compliance with quantity requirements specified for shop drawings.

1.7.7 Number of SD-09 Manufacturer's Field Report Copies

Submit in compliance with quantity and quality requirements specified for shop drawings other than field test results that will be submitted with QC reports.

1.7.8 Number of SD-10 Operation and Maintenance Data Copies

Submit three copies of O&M data to the Contracting Officer for review and approval.

1.7.9 Number of SD-11 Closeout Submittals Copies

Unless otherwise specified, submit three sets of administrative submittals.

1.8 INFORMATION ONLY SUBMITTALS

Submittals without a "G" designation must be certified by the QC manager and submitted to the Contracting Officer for information-only. Approval of the Contracting Officer is not required on information only submittals. The Contracting Officer will mark "receipt acknowledged" on submittals for information and will return only the transmittal cover sheet to the Contractor. Normally, submittals for information only will not be returned. However, the Government reserves the right to return unsatisfactory submittals and require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.9 PROJECT SUBMITTAL REGISTER

A sample Project Submittal Register showing items of equipment and materials for which submittals are required by the specifications is provided as "Appendix A - Submittal Register."

1.9.1 Submittal Management

Prepare and maintain a submittal register, as the work progresses. Do not change data that is output in columns (c), (d), (e), and (f) as delivered by Government; retain data that is output in columns (a), (g), (h), and (i) as approved. As an attachment, provide a submittal register showing items of equipment and materials for which submittals are required by the specifications. This list may not be all-inclusive and additional submittals may be required.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD Number. and type, e.g., SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in each specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting the project requirements.

Column (f): Lists the approving authority for each submittal.

1.9.2 Preconstruction Use of Submittal Register

Submit the submittal register as an electronic database, using the submittal management program furnished to Contractor. Include the QC plan and the project schedule. Verify that all submittals required for the project are listed and add missing submittals. Coordinate and complete the following fields on the register database submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for the approving authority to receive submittals.

Column (h) Contractor Approval Date: Date that Contractor needs approval of submittal.

Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.9.3 Contractor Use of Submittal Register

Update the following fields in the Government-furnished submittal register program or equivalent fields in the program used by the Contractor with each submittal throughout the contract.

Column (b) Transmittal Number: List of consecutive, Contractor-assigned numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) Date submittal transmitted.

Column (q) Date approval was received.

1.9.4 Approving Authority Use of Submittal Register

Update the following fields:

Column (b) Transmittal Number: List of consecutive, Contractor-assigned numbers.

Column (l) Date submittal was received.

Column (m) through (p) Dates of review actions.

Column (q) Date of return to Contractor.

1.9.5 Action Codes

Entries for columns (j) and (o) are to be used as follows (others may be prescribed by the Transmittal Form):

1.9.5.1 Government Review Action Codes

"A" - "Approved as submitted"

"AN" - "Approved as noted"

"RR" - "Disapproved as submitted"; "Completed"

"NR" - "Not Reviewed"

"RA" - "Receipt Acknowledged"

1.9.6 Delivery of Copies

Submit an updated electronic copy of the submittal register to the Contracting Officer with each invoice request. Provide an updated Submittal Register monthly regardless of whether an invoice is submitted.

1.10 VARIATIONS

Variations from contract requirements require Contracting Officer approval pursuant to contract Clause FAR 52.236-21 Specifications and Drawings for Construction, and will be considered where advantageous to the Government.

1.10.1 Considering Variations

Discussion of variations with the Contracting Officer before submission will help ensure that functional and quality requirements are met and minimize rejections and resubmittals. For variations that include design changes or some material or product substitutions, the Government may require an evaluation and analysis by a licensed professional engineer hired by the contractor.

Specifically point out variations from contract requirements in a transmittal letter. Failure to point out variations may cause the Government to require rejection and removal of such work at no additional cost to the Government.

1.10.2 Warranting that Variations are Compatible

When delivering a variation for approval, the Contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.10.3 Review Schedule Extension

In addition to the normal submittal review period, a period of 14 calendar working days will be allowed for the Government to consider submittals with variations.

1.11 SCHEDULING

Schedule and submit concurrently product data and shop drawings covering component items forming a system or items that are interrelated. Submit pertinent certifications at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

- a. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. The Contractor is responsible for additional time required for Government reviews resulting from required resubmittals. The review period for each resubmittal is the same as for the initial submittal.
- b. Submittals required by the contract documents are listed on the submittal register. If a submittal is listed in the submittal register but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but that have been omitted from the register or marked "N/A."
- c. Resubmit the submittal register and annotate it monthly with actual submission and approval dates. When all items on the register have been fully approved, no further resubmittal is required.
- d. Except as specified otherwise, allow a review period, beginning with receipt by the approving authority, that includes at least 15 working days for submittals for QC manager approval and 20 working days for submittals where the Contracting Officer is the approving authority. The period of review for submittals with Contracting Officer approval begins when the Government receives the submittal from the QC organization.
- e. For submittals requiring review by a Government fire protection engineer, allow a review period, beginning when the Government receives the submittal from the QC organization, of 30 working days for return of the submittal to the Contractor.

1.11.1 Reviewing, Certifying, and Approving Authority

The QC Manager is responsible for reviewing all submittals and certifying that they are in compliance with contract requirements. The approving authority on submittals is the QC Manager unless otherwise specified. At each "Submittal" paragraph in individual specification sections, a notation "G" following a submittal item indicates that the Contracting

Officer is the approving authority for that submittal item. Provide an additional copy of the submittal to the Government Approving authority

1.11.2 Constraints

Conform to provisions of this section, unless explicitly stated otherwise for submittals listed or specified in this contract.

Submit complete submittals for each definable feature of the work. At the same time, submit components of definable features that are interrelated as a system.

When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, the submittal will be returned without review.

Approval of a separate material, product, or component does not imply approval of the assembly in which the item functions.

1.11.3 QC Organization Responsibilities

- a. Review submittals for conformance with project design concepts and compliance with contract documents.
- b. Process submittals based on the approving authority indicated in the submittal register.
 - (1) When the QC manager is the approving authority, take appropriate action on the submittal from the possible actions defined in paragraph APPROVED SUBMITTALS.
 - (2) When the Contracting Officer is the approving authority or when variation has been proposed, forward the submittal to the Government, along with a certifying statement, or return the submittal marked "not reviewed" or "revise and resubmit" as appropriate. The QC organization's review of the submittal determines the appropriate action.
- c. Ensure that material is clearly legible.
- d. Stamp each sheet of each submittal with a QC certifying statement or an approving statement, except that data submitted in a bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.
 - (1) When the approving authority is the Contracting Officer, the QC organization will certify submittals forwarded to the Contracting Officer with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with Contract Number _____ is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for Government approval.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Certified by QC Manager _____, Date _____"

(Signature)

- (2) When approving authority is the QC manager, the QC manager will use the following approval statement when returning submittals to the Contractor as "Approved" or "Approved as Noted."

"I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with Contract Number _____ is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is approved for use.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Approved by QC Manager _____, Date _____"
(Signature)

- e. Sign the certifying statement or approval statement. The QC organization member designated in the approved QC plan is the person signing certifying statements. The use of original ink for signatures is required. Stamped signatures are not acceptable.
- f. Update the submittal register as submittal actions occur, and maintain the submittal register at the project site until final acceptance of all work by the Contracting Officer.
- g. Retain a copy of approved submittals and approved samples at the project site.
- h. For "S" submittals, provide a copy of the approved submittal to the Government Approving authority.

1.12 GOVERNMENT APPROVING AUTHORITY

When the approving authority is the Contracting Officer, the Government will:

- a. Note the date on which the submittal was received from the QC manager.
- b. Review submittals for approval within the scheduling period specified and only for conformance with project design concepts and compliance with contract documents.
- c. Identify returned submittals with one of the actions defined in paragraph REVIEW NOTATIONS and with comments and markings appropriate for the action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date submittals.

1.12.1 Review Notations

Submittals will be returned to the Contractor with the following notations:

- a. Submittals marked "approved" or "accepted" authorize proceeding with the work covered.
- b. Submittals marked "approved as noted" or "approved, except as noted,

resubmittal not required," authorize proceeding with the work covered provided that the Contractor takes no exception to the corrections.

- c. Submittals marked "not approved," "disapproved," or "revise and resubmit" indicate incomplete submittal or noncompliance with the contract requirements or design concept. Resubmit with appropriate changes. Do not proceed with work for this item until the resubmittal is approved.
- d. Submittals marked "not reviewed" indicate that the submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.
- e. Submittals marked "receipt acknowledged" indicate that submittals have been received by the Government. This applies only to "information-only submittals" as previously defined.

1.13 DISAPPROVED SUBMITTALS

Make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications, give notice to the Contracting Officer as required under the FAR clause titled CHANGES. The Contractor is responsible for the dimensions and design of connection details and the construction of work. Failure to point out variations may cause the Government to require rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and resubmit in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.14 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing, and other information are satisfactory.

Approval or acceptance by the Government for a submittal does not relieve the Contractor of the responsibility for meeting the contract requirements or for any error that may exist, because under the Quality Control (QC) requirements of this contract, the Contractor is responsible for ensuring information contained within each submittal accurately conforms with the requirements of the contract documents.

After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.15 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not to be construed to change or modify any contract

requirements. Before submitting samples, provide assurance that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those that may be damaged in testing, will be returned to the Contractor, at its expense, upon completion of the contract. Unapproved samples will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make as that material. The Government reserves the right to disapprove any material or equipment that has previously proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Replace such materials or equipment to meet contract requirements.

1.16 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained. No payment will be made for any materials incorporated into the work for any conformance review submittals or information-only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

1.17 CERTIFICATION OF SUBMITTAL DATA

Certify the submittal data as follows on Form ENG 4025: "I certify that the above submitted items had been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.

____NAME OF CONTRACTOR _____ SIGNATURE OF CONTRACTOR

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 14 00	SD-01 Preconstruction Submittals														
			List of Contact Personnel	1.3.1.1													
		01 20 00	SD-01 Preconstruction Submittals														
			Earned Value Report	1.3	G												
		01 30 00	SD-01 Preconstruction Submittals														
			View Location Map	1.3													
			Progress and Completion	1.4													
			Pictures														
		01 30 01.00 22	SD-02 Shop Drawings														
			Contractor's Interior Designer's	1.4.1	G ID												
			Qualifications														
			FF&E Schedule and Schedule		G ID												
			Updates														
			FF&E Concept Presentation		G ID												
			Submittal / Over The Shoulder														
			Review														
			Best Value Determination Pricing		G ID												
			Solicitation / Over The Shoulder														
			Review														
			Best Value Determination		G ID												
			Recommendation FF&E														
			Best Value Determination		G EE												
			Recommendation A/V														
			Preliminary (Pre-Final) FF&E	1.5.3	G ID												
			Package														
			Final FF&E Package	1.4.3	G ID												

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		01 30 01.00 22	Audio Visual Package		G EE												
		01 31 23.13 20	SD-01 Preconstruction Submittals														
			List of Contractor's Personnel	1.4.2	G												
		01 32 17.00 20	SD-01 Preconstruction Submittals														
			Baseline NAS	1.2.2	G												
			Designated Project Scheduler	1.9	G												
			SD-07 Certificates														
			Three-Week Look Ahead	1.3	G												
			Schedule														
			Monthly Network Analysis	1.4.1	G												
			Updates														
			SD-11 Closeout Submittals														
			As-Built Schedule	1.4.2	G												
		01 33 00	SD-01 Preconstruction Submittals														
			Submittal Register	1.9	G												
		01 33 29	SD-01 Preconstruction Submittals														
			Preliminary Sustainability	1.5.1.5	S												
			eNotebook														
			In-Progress Sustainability	1.5.1.5	S												
			eNotebook														
			SD-11 Closeout Submittals														
			Final Sustainability eNotebook	1.5.1	S												
			Final Sustainability eNotebook	1.5.1.5	S												
			Amended Final Sustainability	1.5.1.5	S												
			eNotebook														
		01 35 13	SD-01 Preconstruction Submittals														

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		01 35 13	Watercraft List	3.1													
		01 35 26	SD-01 Preconstruction Submittals														
			Accident Prevention Plan (APP)	1.8	G												
			APP - Construction	1.8.1	G												
			Dive Operations Plan	1.17	G												
			SD-06 Test Reports														
			Monthly Exposure Reports	1.4													
			Notifications and Reports	1.13													
			Accident Reports	1.13.2	G												
			LHE Inspection Reports	1.13.3													
			SD-07 Certificates														
			Contractor Safety Self-Evaluation Checklist	1.5													
			Crane Operators/Riggers	1.7.1.5													
			Standard Lift Plan	1.8.3.2	G												
			Critical Lift Plan	1.8.3.3	G												
			Naval Architecture Analysis	1.8.3.4	G												
			Activity Hazard Analysis (AHA)	1.9													
			Confined Space Entry Permit	1.10.1													
			Hot Work Permit	1.10.1													
			Certificate of Compliance	1.13.4													
			Third Party Certification of	1.13.5													
			Floating Cranes and														
			Barge-Mounted Mobile Cranes														
			License Certificates	1.15													

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		01 35 26	Radiography Operation Planning Work Sheet	1.15.1	G												
			Portable Gauge Operations Planning Worksheet	1.15.1	G												
		01 35 29.13	SD-02 Shop Drawings														
			Work Zones	3.9.1	G												
			Decontamination Areas	3.10.1	G												
			Decontamination Areas	3.10.1	G												
			SD-03 Product Data														
			Amendments to the APP/SSHP	1.4													
			Exposure Monitoring/Air Sampling Program	3.5													
			Site Control Log	3.9.2													
			SSHO's Daily Inspection Logs	1.8													
			SD-07 Certificates														
			Certificate Of Worker/Visitor Acknowledgement	1.7													
			SD-11 Closeout Submittals														
			Safety And Health Phase-Out Report	1.9													
		01 35 40.00 20	SD-01 Preconstruction Submittals														
			Marine Mammal Monitoring Plan	1.2.1	G												
			Acoustic Monitoring Plan	1.2.1	G												
			Protected Species Observer Qualifications	1.2.2	G												

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		01 35 40.00 20	SD-09 Manufacturer's Field Reports														
			Draft Marine Mammal Monitoring and Acoustic Monitoring Reports	1.2.4	G												
			Marine Mammal Monitoring Data Collection Forms	1.2.3	G												
			SD-11 Closeout Submittals														
			Marine Mammal Monitoring and Acoustic Monitoring Final Reports	1.2.5													
		01 45 00.00 20	SD-01 Preconstruction Submittals														
			Construction Quality Control (QC) Plan	1.6.1	G												
			Indoor Air Quality (IAQ) Management Plan	1.16	G												
			Final IAQ Management Plan	1.16	S												
		01 45 35	SD-06 Test Reports														
			Daily Reports	3.1.2													
			Biweekly Reports	3.1.1													
			SD-07 Certificates														
			AISC Certified Steel Fabricator	2.1													
			Steel Joist Institute Membership	2.1													
			Certificate of Compliance	2.1													
			Special Inspector	1.5	G												
			SD-11 Closeout Submittals														
			Interim Report	3.1.2	G												
			Comprehensive Final Report	3.1.2	G												

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		01 50 00	SD-01 Preconstruction Submittals														
			Construction Site Plan	1.3	G												
			Traffic Control Plan	3.4.1	G												
			Haul Road Plan	2.2.1	G												
			Contractor Computer	1.6.1.4	G												
			Cybersecurity Compliance														
			Statements														
			Contractor Temporary Network	1.6.6	G												
			Cybersecurity Compliance														
			Statements														
			SD-03 Product Data														
			Backflow Preventers	1.4	G												
			SD-06 Test Reports														
			Backflow Preventer Tests	3.5													
			SD-07 Certificates														
			Backflow Tester	1.4.1													
			Backflow Preventers	1.4													
		01 57 19	SD-01 Preconstruction Submittals														
			Preconstruction Survey	1.6.1													
			Solid Waste Management Permit	1.10	G												
			Regulatory Notifications	1.6.2	G												
			Environmental Protection Plan	1.7	G												
			Stormwater Management Plan	3.2.1.1	G												
			Stormwater Notice of Intent	3.2.1.2	G												
			Dirt and Dust Control Plan	1.7.9.1	G												
			Employee Training Records	1.6.5	G												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 57 19	Environmental Manager Qualifications	1.6.4	G												
			SD-06 Test Reports														
			Laboratory Analysis	3.7.1.1.2													
			Inspection Reports	3.2.1.3													
			Monthly Solid Waste Disposal Report	1.10.1	G												
			SD-07 Certificates														
			Employee Training Records	1.6.5	G												
			ECATTS Certificate of Completion	1.4.1.2	G												
			Erosion and Sediment Control Inspector	1.6.5													
			SD-11 Closeout Submittals														
			Stormwater Management Plan	3.2.1.4	G												
			Compliance Notebook														
			Stormwater Notice of Termination	3.2.1.5	G												
			Waste Determination Documentation	3.7.1	G												
			Disposal Documentation for Hazardous and Regulated Waste	3.7.3.6	G												
			Assembled Employee Training Records	1.6.5	G												
			Solid Waste Management Permit	1.10	G												
			Project Solid Waste Disposal Documentation Report	3.7.2.1	G												

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION REVIEW WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 57 19	Contractor Hazardous Material Inventory Log	3.8.1	G												
			Hazardous Waste/Debris Management	3.7.3.1	G												
			Regulatory Notifications	1.6.2	G												
			Sales Documentation	3.7.2.1	G												
			As-Built Topographic Survey	3.2.1.5													
		01 57 19.01 20	SD-01 Preconstruction Submittals														
			Regulatory Notifications		G												
			SD-06 Test Reports														
			Laboratory Analysis														
			Inspection Reports														
			SD-11 Closeout Submittals														
			Closure Reports														
			Waste Determination		G												
			Documentation														
			Disposal Documentation for		G												
			Hazardous and Regulated Waste														
			Annual Notifications (performed by Navy)														
			Annual Reports (performed by Navy)														
		01 57 24	SD-01 Preconstruction Submittals														
			Turbidity Control Plan	1.7	G												
			SD-03 Product Data														
			Buoy-Mounted Turbidity Monitors	2.1	G												

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		01 57 24	Hand-Held Turbidity Monitor	2.2	G												
		01 58 00	SD-02 Shop Drawings														
			Preliminary Drawing Indicating Layout And Text Content	1.4.1	G												
			SD-04 Samples														
			Facility Recognition Plaque	1.3.1	G												
		01 74 19	SD-01 Preconstruction Submittals														
			Construction Waste Management Plan	1.7	G												
			SD-11 Closeout Submittals														
			Final Construction Waste Diversion Report	1.9	S												
		01 78 00	SD-03 Product Data														
			Warranty Management Plan	1.6.1													
			Warranty Tags	1.6.4													
			Final Cleaning	3.3													
			Spare Parts Data	1.5													
			SD-08 Manufacturer's Instructions														
			Instructions	1.6.1													
			SD-11 Closeout Submittals														
			As-Built Drawings	3.1	G												
			Record Drawings	3.2	G												
			As-Built Record of Equipment and Materials	1.6.1													
			Certification of EPA Designated Items	2.1	G												

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		01 78 00	Certification Of USDA Designated Items	2.2	G												
			Interim DD FORM 1354	3.4.1	G												
			Checklist for DD FORM 1354	3.4.2	G												
			High Performance and Sustainable Building (HPSB) Checklist	3.4.2	G												
		01 78 23	SD-10 Operation and Maintenance Data														
			Training Plan	3.1.1	G												
			Training Outline	3.1.3	G												
			Training Content	3.1.2	G												
			SD-11 Closeout Submittals														
			Training Video Recording	3.1.4	G												
			Validation of Training Completion	3.1.6	G												
		01 78 24.00 20	SD-11 Closeout Submittals														
			eOMSI, Progress Submittal	1.4.1	G												
			eOMSI, Prefinal Submittal	1.4.2	G												
			eOMSI, Final Submittal	1.4.3	G												
		01 91 00.15 20	SD-05 Design Data														
			Design Phase Commissioning Plan	3.1	G												
			SD-06 Test Reports														
			Design Review Report	3.2	G												
			Design Review Report	3.2	G												

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		01 91 00.15 20	Final Construction Phase Commissioning Plan	3.6	G												
			Issues Log	1.11	G												
			Completed Pre-Functional Checklists	3.7	G												
			SD-07 Certificates														
			Commissioning Firm	1.8	G												
			Certificate Of Readiness	1.12	G												
			SD-11 Closeout Submittals														
			Final Commissioning Report	3.10	G												
			Updated Final Commissioning Report	3.11	G												
		02 41 00	SD-01 Preconstruction Submittals														
			Demolition Plan	1.2.2	G												
			Existing Conditions	1.9													
			SD-07 Certificates														
			Notification	1.6	G												
			SD-11 Closeout Submittals														
			Receipts	3.3.4													
		02 61 13	SD-01 Preconstruction Submittals														
			Work Plan	1.2.2	G												
			Soil and Contaminated Material Management Plan	3.3.1	G												
			Dig Permit	3.1	G												
			SD-02 Shop Drawings														
			Surveys														

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		02 61 13	SD-06 Test Reports														
			Compaction	3.7.1													
			Closure Report	3.9	G												
			Waste Determination Forms														
			Waste Manifest		G												
		02 81 00	SD-03 Product Data														
			Packaging Notifications	2.1.1													
			Hazardous Waste Management Plan	3.1	G												
			Onsite Hazardous Waste Management	3.2	G												
			Notices of Non-Compliance and Notices of Violation	3.3													
			SD-06 Test Reports														
			Recordkeeping	3.5	G												
			Exception Report	3.5	G												
			Spill Response	3.6													
			SD-07 Certificates														
			Transportation and Disposal Coordinator	1.4.1	G												
			Training	1.4.2	G												
			Certification	1.4.3													
			Shipping Documents and Packaging Certification	3.3.3	G												
			Security Plan	3.3.4													
			Certificates of Disposal	3.3.5													

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		02 81 00	Waste Minimization	3.4													
		03 30 00	SD-01 Preconstruction Submittals														
			Quality Control Plan	1.6.6													
			Quality Control Personnel	1.6.7													
			Certifications														
			Quality Control Organizational	1.6.7													
			Chart														
			Laboratory Accreditation	1.6.9													
			Maturity Method Data	3.3.9													
			SD-02 Shop Drawings														
			Reinforcing Steel	1.6.2.1	G												
			SD-03 Product Data														
			Joint Sealants	2.4.4													
			Joint Filler	2.4.3													
			Formwork Materials	2.1													
			Recycled Aggregate Materials	2.3.3.2													
			Cementitious Materials	2.3.1													
			Vapor Barrier	2.4.5													
			Concrete Curing Materials	2.4.1													
			Reinforcement	2.6													
			Admixtures	2.3.4													
			Waterstops	2.2.2													
			Biodegradable Form Release	2.2.3													
			Agent														
			Nonshrink Grout	2.4.2													
			SD-05 Design Data														

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		03 30 00	Concrete Mix Design	1.6.1.1	G												
			SD-06 Test Reports														
			Concrete Mix Design	1.6.1.1	G												
			Fly Ash	1.6.4.1													
			Pozzolan	1.6.4.1													
			Slag Cement	1.6.4.2													
			Aggregates	1.6.4.3													
			Tolerance Report	3.9.2.1													
			Compressive Strength Tests	3.12.2.3	G												
			Air Content	3.12.2.4													
			Slump Tests	3.12.2.1													
			Water	2.3.2													
			SD-07 Certificates														
			Reinforcing Bars	2.6.1													
			VOC Content for Form Release	1.6.3.1													
			Agents, Curing Compounds, and														
			Concrete Penetrating Sealers														
			Safety Data Sheets	1.6.3.2													
			Forest Stewardship Council	1.8.2	S												
			(FSC) Certification														
			Field Testing Technician and	1.6.7.2													
			Testing Agency														
			Recycled Content	1.7.1	S												
			Regional Material	1.8.1	S												
			Legal Wood	1.3.1.3	S												
			SD-08 Manufacturer's Instructions														

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		03 30 00	Joint Sealants	2.4.4													
			Curing Compound	2.4.1													
		03 31 30	SD-01 Preconstruction Submittals														
			Concrete Curing Plan	1.9.2.2													
			Concrete Qualification Program	1.8.4	G												
			Concrete Quality Control Program	1.7	G												
			Concrete Placement and Compaction	1.9.2.4													
			Concrete Pumping	1.9.2.4													
			Curing Concrete Elements	1.9.2.1													
			Form Removal Schedule	1.9.2.3													
			Laboratory Qualifications	1.7.2	G												
			Quality Control Personnel	1.7.1	G												
			SD-02 Shop Drawings														
			Expansion Joints	3.2.8	G												
			Formwork	1.9.1.1													
			Joints	1.9.1.3	G												
			Reinforcing Steel	1.7.1.2	G												
			SD-03 Product Data														
			Admixtures	1.9.5.5	G												
			Air Entraining	2.4.1	G												
			Aggregates	1.9.5.4	G												
			Headed Reinforcing Bars	2.7.4	G												
			Hydrophilic Waterstops	2.8.2	G												
			Joint Filler	2.8.4													
			Joint Sealants	2.8.5													

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		03 31 30	Materials for Curing Concrete	2.8.3													
			Safety Data Sheets	1.9.2.7													
			Mechanical Reinforcing Bar	2.7.2	G												
			Connectors														
			Non-Shrink Grout	2.5													
			Preformed Joint Filler	3.2.8													
			Reinforcing Bars	2.7.1	G												
			Reinforcement Supports	3.2.2													
			Synthetic Fibers	2.7.6	G												
			Waterstops	2.8.1													
			Welded Wire Fabric	2.7.3													
			SD-04 Samples														
			Test Section	1.9.5.8													
			SD-05 Design Data														
			Concrete Mixture Requirements	1.9.5.1	G												
			Mixture Designs	1.9.2.8													
			SD-06 Test Reports														
			Air Entraining	2.4.1													
			Aggregates	1.9.5.4													
			Admixtures	1.9.5.5													
			Cement	1.9.5.6													
			Concrete Mixture Proportions	1.8.1													
			Concrete Test Reports	1.9.5													
			Fresh Concrete Properties	1.8.4.1													
			Hardened Concrete Properties	1.8.4.2													

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		03 31 30	Mechanical Reinforcing Bar	2.7.2													
			Connectors														
			Reinforcing Bars	2.7.1													
			Supplementary Cementing	1.9.5.2													
			Materials														
			Water	2.3													
			SD-07 Certificates														
			Admixtures	1.9.5.5													
			Cementitious Materials	2.1													
			Cementitious Material Mill	1.9.3.1													
			Certificates														
			Field Testing Technician and	1.7.1.2													
			Testing Agency														
			SD-11 Closeout Submittals														
			Aggregate Moisture Content	1.9.3.1													
			Aggregate Sampling	1.9.3.1													
			Concrete Test Reports	1.9.5													
			Quality Control Charts	1.9.4.3													
			Daily Inspection Reports	1.9.4.1													
			Sampling Logs	1.9.4.2													
		03 42 13.00 10	SD-01 Preconstruction Submittals														
			Quality Control Procedures	1.4.2.2													
			SD-02 Shop Drawings														
			Standard Precast Units	2.1.1	G												
			Custom-Made Precast Units	2.1.2	G												
			Special Finishes	3.2.4.3													

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		03 42 13.00 10	SD-03 Product Data														
			Standard Precast Units	2.1.1													
			Proprietary Precast Units	2.1.3													
			Embedded Items	3.1.3													
			Accessories	2.2.6													
			SD-05 Design Data														
			Design Calculations	2.1.2	G												
			Concrete Mix Proportions	2.1.5.1													
			SD-06 Test Reports														
			Test Reports	1.4.2.4													
			SD-07 Certificates														
			Quality Control Procedures	1.4.2.2													
			SD-11 Closeout Submittals														
			Recycled content for fly ash and pozzolan	2.2.1	S												
			Recycled content for Ground Iron Blast-Furnace Slag	2.2.1	S												
			Recycled content for Silica Fume	2.2.1	S												
			Recycled content for Synthetic Fiber Reinforcement	2.2.1	S												
			Recycled content for steel	2.2.1	S												
		03 45 33	SD-02 Shop Drawings														
			Drawings of Precast Prestressed Concrete Members	2.1.1.2	G												
			SD-03 Product Data														
			Inserts	2.2.9.1	G												

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		03 45 33	Bearing Pads	2.2.10	G												
			SD-05 Design Data														
			Handling Calculations	2.1.1.2	G												
			Concrete Mix Design	1.4.3	G												
			SD-06 Test Reports														
			Concrete Mix Design	1.4.3	G												
			Fly Ash	2.2.2.1													
			Ground Granulated Blast-Furnace Slag	2.2.2.2													
			Aggregates	2.2.4													
			Concrete and Aggregate Quality Control Testing	1.4.1.1													
			Water	2.2.3													
			SD-07 Certificates														
			Quality Control Procedures	2.3													
			Construction Records	3.12	G												
			SD-11 Closeout Submittals														
			Batch Ticket	1.4.4													
			Recycled Content for Fly Ash and Pozzolan	2.2.1	S												
			Recycled Content for Ground Iron Blast-Furnace Slag	2.2.1	S												
		04 20 00	SD-02 Shop Drawings														
			Cut CMU	3.3.2.1	G												
			Detail Drawings	3.4.1.1	G												
			SD-03 Product Data														

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		04 20 00	Hot Weather Procedures	1.5.1	G												
			Cold Weather Procedures	1.5.2	G												
			Cement	2.2.2.2.1	G												
			Cementitious Materials	2.4.1.1	G												
			Precast Splashblock	2.2.3.2	G												
			SD-04 Samples														
			Concrete Masonry Units (CMU)	2.2.2.2	G												
			SD-05 Design Data														
			Masonry Compressive Strength	2.1.2	G												
			SD-06 Test Reports														
			Field Testing of Mortar	3.6.1.1													
			Field Testing of Grout	3.6.1.2													
			Prism Tests	3.6.1.3													
			Single-Wythe Masonry Wall	3.6.1.4													
			Water Penetration Test														
			SD-07 Certificates														
			Special Masonry Inspector	1.3.1													
			Qualifications														
			VOC Emissions	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Recycled Content	2.2.2.2.2	S												
			Regional Material	1.2.1.2	S												
			Concrete Masonry Units (CMU)	2.2.2.2													
			Precast Concrete Units	2.2.3													
			Cementitious Materials	2.4.1.1													
			Admixtures for Masonry Mortar	2.4.1.3													

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		04 20 00	Admixtures for Grout	2.4.2.2													
			Anchors, Ties, and Bar	2.6.2													
			Positioners														
			Joint Reinforcement	2.6.3													
			SD-08 Manufacturer's Instructions														
			Admixtures for Masonry Mortar	2.4.1.3													
			Admixtures for Grout	2.4.2.2													
			SD-10 Operation and Maintenance														
			Data														
			Take-Back Program	3.8	S												
		05 05 20.00 27	SD-01 Preconstruction Submittals														
			Installer Qualifications	1.5.1.1													
			Post-Installed Anchor Special	1.5.1.2													
			Inspector Qualifications														
			SD-03 Product Data														
			Mechanical Anchors in Concrete	2.1.1.3	G												
			Adhesive Anchor System in	2.1.1.4	G												
			Concrete														
			Mechanical and Adhesive	2.1.1.5	G												
			Anchors in Masonry														
			Non-Shrink, Non-Metallic Grout	3.1.3													
			SD-06 Test Reports														
			Post-Installed Anchor Special	3.3.4													
			Inspections Report														
			SD-07 Certificates														

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		05 05 20.00 27	Post-Installed Anchor Certification	2.1.1.1													
			SD-08 Manufacturer's Instructions														
			Manufacturer's Printed Installation Instructions	2.1.1.2													
			Non-Shrink, Non-Metallic Grout	3.1.3													
			Manufacturer's Material Safety Data Sheets	1.5													
		05 05 23.16	SD-01 Preconstruction Submittals														
			Welding Quality Assurance Plan	3.2													
			SD-03 Product Data														
			Welding Procedure Qualifications	1.3													
			Welder, Welding Operator, and Tacker Qualification	1.3.3													
			Previous Qualifications	1.3.1													
			Pre-Qualified Procedures	1.3.2													
			Welding Electrodes and Rods	2.2													
			SD-06 Test Reports														
			Nondestructive Testing	3.3													
			Weld Inspection Log	3.2													
			SD-07 Certificates														
			Certified Welding Inspector	1.3.4													
			Nondestructive Testing Personnel	1.3.4													
		05 12 00	SD-01 Preconstruction Submittals														
			Erection and Erection Bracing Drawings	1.4.1.1													

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		05 12 00	SD-02 Shop Drawings														
			Fabrication Drawings	1.4.2	G												
			SD-03 Product Data														
			Shop Primer	2.6.2													
			Welding Electrodes and Rods	2.4.1													
			Direct Tension Indicator Washers	2.3.2.3													
			Non-Shrink Grout	2.4.2													
			SD-06 Test Reports														
			Weld Inspection Reports	3.7.1.2													
			Direct Tension Indicator Washer	3.7.2.1													
			Inspection Reports														
			Bolt Testing Reports	3.7.3.1													
			Embrittlement Test Reports	3.7.4													
			SD-07 Certificates														
			Steel	2.2													
			Galvanizing	2.5													
			Welding Procedures and	1.4.3.1													
			Qualifications														
			Welding Electrodes and Rods	2.4.1													
			Certified Welding Inspector	3.7.1.1													
			NDT Technician	3.7.1.2													
			Welding Procedure Specifications	3.4													
			(WPS)														
			Recycled Content	1.3.1	S												
			Recycled Content	2.2.1	S												
			Regional Material	1.3.1	S												

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		05 21 00	SD-01 Preconstruction Submittals														
			Welder Qualification	1.4.2													
			SD-02 Shop Drawings														
			Steel Joist Framing	1.4.1	G												
			SD-05 Design Data														
			Design Calculations	2.2	G												
			SD-06 Test Reports														
			Erection Inspection	3.4													
			Welding Inspections	3.4													
			SD-07 Certificates														
			Certification of Compliance	1.4.2													
			Recycled Content	1.3.1													
			Recycled Content	2.3													
			Recycled Content of Steel Products	2.3	S												
			Regional Material	1.3.1	S												
		05 30 00	SD-02 Shop Drawings														
			Fabrication Drawings	1.4.5	G												
			SD-03 Product Data														
			Accessories	2.2													
			Deck Units	2.1													
			Galvanizing Repair Paint	2.1.4													
			Mechanical Fasteners	2.2.14													
			Touch-Up Paint	2.1.4													
			Welding Equipment	1.4.3													
			Welding Rods and Accessories	1.4.3													

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 30 00	SD-05 Design Data														
			Deck Units	2.1	G												
			SD-07 Certificates														
			Powder-Actuated Tool Operator	1.4.2													
			Welder Qualifications	1.4.3													
			Welding Procedures	1.4.3													
			Fire Safety	1.4.4.1													
			Wind Storm Resistance	1.4.4.2													
			Manufacturer's Certificate	1.4.1													
			Stud Manufacture's Certification	2.2.9													
			Stud Manufacture's Test Reports	2.2.9													
			Recycled Content	1.3.1	S												
			Recycled Content	2.1	S												
			Regional Material	1.3.1	S												
		05 40 00	SD-02 Shop Drawings														
			Framing Components	1.7.1	G												
			SD-03 Product Data														
			Studs, Joists	2.1													
			SD-05 Design Data														
			Metal Framing Calculations	1.7.2	G												
			SD-07 Certificates														
			Load-Bearing Cold-Formed Metal	1.5													
			Framing														
			Welds	3.1.1													
			Recycled Content	1.3.1	S												
			Recycled Content	2.1	S												

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 40 00	Regional Material	1.3.1	S												
		05 50 13	SD-02 Shop Drawings														
			Bollards	2.4	G												
			Roof Hatches	2.7	G												
			Canopies	2.8.1	G												
			Sunshades	2.8.2	G												
			Shelf w/ Hanging Rod	2.9.1	G												
			Wire Mesh Screen	2.9.2	G												
			Rooftop Mechanical Screenwall	2.10	G												
			Dock Bumper	2.11	G												
			Downspout Boot	2.5													
			Downspout Boot	2.5													
			SD-03 Product Data														
			Roof Hatches	2.7	G												
			Downspout Boot	2.5	G												
			Downspout Boot	2.5	G												
			Downspout Boot	2.5	G												
			Downspout Boot	2.5	G												
			Canopies	2.8.1	G												
			Sunshades	2.8.2	G												
			Rooftop Mechanical Screenwall	2.10	G												
			Dock Bumper	2.11	G												
			SD-04 Samples														
			Rooftop Mechanical Screenwall	2.10	G												
			SD-05 Design Data														
			Canopy Calculations	2.8	G												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 50 13	Sunshade Calculations	2.8	G												
			Rooftop Mechanical Screenwall Calculations	2.10	G												
			SD-07 Certificates														
			Recycled Content	1.3.1.1	S												
			Recycled Content	2.1	S												
			Regional Material	1.3.1.1	S												
			Certificates of Compliance	2.1													
			Certified Mill	2.2													
		05 50 14	SD-02 Shop Drawings														
			Detail Drawings	1.4.1	G												
			Welding Procedures	2.1.2.1.1	G												
			Welding Repair Plan	2.2.3													
			SD-03 Product Data														
			Filler Metal	2.1.2.1.3.1													
			SD-06 Test Reports														
			Tests, Inspections, and Verifications	2.2													
			SD-07 Certificates														
			Welding Qualifications	1.4.2													
			Weld Inspection Log	2.2.2.1													
			Certified Welding Inspector	2.2.2.1													
			Nondestructive Testing Personnel	2.2.2.2.1													
		05 50 16	SD-02 Shop Drawings														
			Cover Plates and Frames	2.5	G												
			Waterfront Gratings	2.8	G												

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		05 50 16	Fender System Wale	2.4	G												
			Life Ring Support Frame	2.4	G												
			Safety Ladder	2.4	G												
			Utility Trench Covers	2.4	G												
			Utility Vaults	2.4	G												
			Guard Railing	2.4	G												
			Guard Railing	3.12	G												
			Bollards/Pipe Guards/Guard Posts	2.9	G												
			SD-03 Product Data														
			Epoxy Anchors	2.2.8.1	G												
			Epoxy Anchors	2.2.8.1	G												
			Cover Plates and Frames	2.5	G												
			Waterfront Gratings	2.8	G												
			Recycled Content	2.1	S												
			Certificates of Compliance	2.1													
			Certified Mill	2.2													
			Lifting Slings	2.5	G												
			Lifting Slings	2.6	G												
			Lifting Slings	3.8	G												
			SD-06 Test Reports														
			Proof Test	3.3.2	G												
		05 51 00	SD-02 Shop Drawings														
			Metal Stair System	2.2.1	G												
			SD-03 Product Data														
			Masonry Anchorage Devices	2.3.3													

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		05 51 00	Protective Coating	2.2.3													
			Steel Pan Stairs	2.2.2	G												
			Steel Stairs	2.3.1													
			SD-07 Certificates														
			Welding Procedures	1.4.1													
			Welder Qualification	1.4.1													
			Recycled Content	1.3.1	S												
			Regional Material	1.3.1	S												
		05 51 33	SD-02 Shop Drawings														
			Ladders	2.3													
			SD-03 Product Data														
			Telescoping Safety Post	2.3													
			SD-07 Certificates														
			Fabricator Certification for Ladder Assembly	1.4													
			Recycled Content	1.3.1.1	S												
			Regional Material	1.3.1.1	S												
		05 52 00	SD-02 Shop Drawings														
			Fabrication Drawings	1.2.1	G												
			SD-03 Product Data														
			Structural-Steel Plates, Shapes, and Bars	2.3.2	G												
			Concrete Inserts	2.3.4	G												
			Masonry Anchorage Devices	2.3.5	G												
			Steel Railings and Handrails	2.3.7	G												
			Aluminum Railings and Handrails	2.3.8	G												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 52 00	Anchorage and Fastening Systems	1.2.1	G												
			SD-04 Samples														
			Finish Samples	1.6	G												
			SD-07 Certificates														
			Welding Procedures	1.4.1	G												
			Welder Qualification	1.4.2	G												
			SD-08 Manufacturer's Instructions														
			Installation Instructions	3.2													
			Recycled Content	1.3.1.1	S												
			Regional Material	1.3.1.1	S												
		06 10 00	SD-02 Shop Drawings														
			Nailing Strips	2.2.1	G												
			SD-03 Product Data														
			Fire-retardant Treatment	1.8													
			Adhesives	2.4.2													
			SD-06 Test Reports														
			Preservative-treated	1.4.3													
			SD-07 Certificates														
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Forest Stewardship Council (FSC)	1.2.1.2	S												
			Regional Material	1.2.1.2	S												
			VOC Emissions	1.2.1.3	S												
			Legal Wood	1.2.1.4	S												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		06 10 00	Certified Sustainably Harvested Virgin Lumber	2.1.1	S												
			Certified Sustainably Harvested Framing Lumber	2.2.1	S												
			Certified Sustainably Harvested Plywood	1.2.1.4	S												
			Preservative Treatment	1.7													
		06 13 33	SD-02 Shop Drawings														
			Timberwork	3.2.1	G												
			SD-06 Test Reports														
			Preservative Treatment	1.5.1	G												
			Delivery Inspection List	1.5.3	G												
			SD-07 Certificates														
			SDS and CIS	1.5.2	G												
			Pesticide Applicator	1.5.4	G												
			Best Management Practices (BMPs)	1.5.5	G												
		06 41 16.00 10	SD-02 Shop Drawings														
			Shop Drawings	2.9	G												
			Installation	3.1													
			SD-03 Product Data														
			Wood Materials	2.1													
			Finish Schedule	2.9.7.3													
			SD-04 Samples														
			Plastic Laminates	2.3	G												
			Cabinet Hardware	2.6													

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		06 41 16.00 10	SD-07 Certificates														
			Quality Assurance	1.4													
			Laminate Clad Casework	3.1													
			EPD	1.3.1.1	S												
			Recycled Content	1.3.1.2	S												
			Forest Stewardship Council (FSC) Certification	1.3.1.2	S												
			Regional Material	1.3.1.2	S												
			VOC Emissions	1.3.1.3	S												
			Formaldehyde Emissions	1.3.1.3	S												
			Legal Wood	1.3.1.4	S												
		06 61 16	SD-02 Shop Drawings														
			Detail Fabrication Drawings	2.1	G												
			Installation	3.1													
			SD-03 Product Data														
			Solid Polymer	2.1.1	G												
			Indoor air quality for solid surface seam and sealant products	2.2.2	S												
			SD-04 Samples														
			Material	2.1	G												
			Material	2.1.1	G												
			SD-06 Test Reports														
			Test Report Results	2.1.1													
			SD-07 Certificates														
			Qualifications	1.4.1													
			EPD	1.3.1.1	S												

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		06 61 16	Recycled Content	1.3.1.2	S												
			Regional Material	1.3.1.2	S												
			VOC Emissions	1.3.1.3	S												
			Indoor Air Quality for solid surface fabrication products	2.1.1	S												
			SD-10 Operation and Maintenance Data														
			Solid Polymer	2.1.1	G												
		07 05 23	SD-01 Preconstruction Submittals														
			Work Plan	1.4	G												
			SD-03 Product Data														
			Thermal Imaging Camera	2.2	G												
			SD-07 Certificates														
			Pressure Test Agency	1.6.2.1													
			Thermographer Qualifications	1.6.2.2													
			Test Instruments	1.6.3													
			Date Of Last Calibration	1.6.3													
			SD-06 Test Reports														
			Pressure Test Procedures	3.5	G												
			Air Leakage Test Report	1.6.4	G												
			Air Leakage Test Report	3.5.5	G												
			Diagnostic Test Report	1.6.4	G												
			Diagnostic Test Report	3.6.5	G												
		07 13 53	SD-03 Product Data														
			Manufacturer's Standard Details	1.4	G												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 13 53	Elastomeric Waterproofing Sheet Material	2.2	G												
			Protection Board	2.4	G												
			Primers, Adhesives, and Mastics	1.5	G												
			Primers, Adhesives, and Mastics	2.2	G												
			SD-06 Test Reports														
			Elastomeric Waterproofing Sheet Material	2.2	G												
			Field Quality Control	3.6	G												
			Protective Covering	3.7	G												
			SD-07 Certificates														
			Elastomeric Waterproofing Sheet Material	2.2													
			Primers, Adhesives, and Mastics	1.5													
			Primers, Adhesives, and Mastics	2.2													
			Protective Coverings	1.5													
			Special Warranties	1.9													
			Special Warranties	1.9													
			Certificates Of Compliance	2.1.1													
			Certificates Of Compliance	2.1.2													
			Regional Material	1.3.1	S												
			Recycled Content	1.3.1	S												
			SD-08 Manufacturer's Instructions														
			Primers, Adhesives, and Mastics	1.5													
			Primers, Adhesives, and Mastics	2.2													
			SD-11 Closeout Submittals														

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 13 53	Certificates Of Compliance	2.1.1	G												
			Certificates Of Compliance	2.1.2	G												
		07 21 13	SD-03 Product Data														
			Manufacturer's Standard Details	1.4	G												
			Block or Board Insulation	2.1	G												
			Protection Board or Coatings	1.5	G												
			Accessories	2.5	G												
			SD-07 Certificates														
			Block or Board Insulation	2.1	G												
			Protection Board or Coating	2.4	G												
			Protection Board or Coating	3.4.5	G												
			Special Warranties	1.8													
			Special Warranties	1.8													
			EPD	1.3.1	S												
			Recycled Content	1.3.2	S												
			Recycled Content	2.1.4	S												
			Regional Material	1.3.2	S												
			VOC Emissions	1.3.3	S												
			VOC Emissions	2.1.5	S												
			SD-08 Manufacturer's Instructions														
			Block or Board Insulation	2.1													
			Adhesive	2.5.1													
		07 21 16	SD-03 Product Data														
			Blanket Insulation	2.1													
			Accessories	2.3													
			SD-07 Certificates														

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		07 21 16	EPD	1.3.1	S												
			Recycled Content	1.3.2	S												
			Recycled Content	2.1.1	S												
			Regional Material	1.3.2	S												
			VOC Emissions	1.3.3	S												
			SD-08 Manufacturer's Instructions														
			Insulation	3.3.1													
		07 22 00	SD-02 Shop Drawings														
			Insulation Board Layout	1.3	G												
			Verification of Existing Conditions	1.3	G												
			SD-03 Product Data														
			Insulation	2.1	G												
			Cover Board	1.4	G												
			Fasteners	2.3	G												
			SD-06 Test Reports														
			Flame Spread Rating	1.8.1	G												
			SD-07 Certificates														
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Recycled Content	2.1.2	S												
			Regional Material	1.2.1.2	S												
			VOC Emissions	1.2.1.3	S												
			Installer Qualifications	1.6	G												
			SD-08 Manufacturer's Instructions														
			Fasteners	2.3	G												
			Insulation	2.1	G												

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		07 27 10.00 10	SD-02 Shop Drawings														
			Air Barrier System Shop Drawings	2.1	G												
			SD-03 Product Data														
			Air Barrier System Product Data	2.1	G												
			SD-04 Samples														
			Mock-Up	3.1.2	G												
			Material Samples For Air Barrier System	2.1	G												
			SD-05 Design Data														
			Design Data And Calculations For The Air Barrier System	1.8	G												
			SD-06 Test Reports														
			Design Review Report	1.8	G												
			Testing and Inspection	3.1.3	G												
			SD-07 Certificates														
			EPD	1.5.1.1	S												
			Air Barrier Inspector	1.7	G												
		07 27 19.01	SD-01 Preconstruction Submittals														
			Qualifications of Manufacturer	1.9.1	G												
			Qualifications of Installer	1.9.2	G												
			Manufacturer's Technical Representative	1.9.1.1	G												
			SD-02 Shop Drawings														
			Self-adhering Air Barrier	1.5	G												
			SD-03 Product Data														

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		07 27 19.01	Self-adhering Air Barrier	1.5	G												
			Primers, Adhesives, and Mastics	2.2	G												
			Safety Data Sheets	1.5.2													
			SD-04 Samples														
			Self-adhering Air Barrier	1.5	G												
			SD-06 Test Reports														
			Field Peel Adhesion Test	1.7	G												
			Flame Propagation of Wall Assemblies	1.5.4	G												
			Flame Spread and Smoke Developed Index Ratings	1.5.4	G												
			Site Inspections and Testing	3.4.1	G												
			SD-07 Certificates														
			Self-adhering Air Barrier	1.5	G												
			EPD	1.4.1	S												
			Recycled Content	1.4.2	S												
			Regional Material	1.4.2	S												
			SD-08 Manufacturer's Instructions														
			Self-adhering Air Barrier	1.5	G												
			Primers, Adhesives, and Mastics	2.2	G												
			SD-09 Manufacturer's Field Reports														
			Field Inspection Reports	1.9.1.1	G												
		07 27 26	SD-01 Preconstruction Submittals														
			Qualifications of Manufacturer	1.10.1	G												
			Qualifications of Installer	1.10.2	G												

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		07 27 26	SD-02 Shop Drawings														
			Fluid-Applied Membrane Air Barrier	1.5	G												
			SD-03 Product Data														
			Fluid-Applied Membrane Air Barrier	1.5	G												
			Transition Membrane	2.3	G												
			Primers, Adhesives, and Mastics	2.2	G												
			Reinforcement	2.6	G												
			Safety Data Sheets	1.5.2	G												
			SD-04 Samples														
			Mockup	1.5.3	G												
			SD-06 Test Reports														
			Capillary Moisture Test	1.7													
			Field Peel Adhesion Test	1.5.4													
			Flame Propagation of Wall Assemblies	1.5.4													
			Flame Spread and Smoke Developed Index Ratings	1.5.4													
			Site Inspections	3.4.1													
			SD-07 Certificates														
			EPD	1.4.1	S												
			Recycled Content	1.4.2	S												
			Regional Material	1.4.2	S												
			Fluid-Applied Membrane Air Barrier	1.5													

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		07 27 26	Transition Membrane	2.3													
			SD-08 Manufacturer's Instructions														
			Fluid-Applied Membrane Air Barrier	1.5	G												
			Transition Membrane	2.3	G												
			Primers, Adhesives, and Mastics	2.2	G												
		07 41 13	SD-02 Shop Drawings														
			Roofing Panels	1.4.4	G												
			Soffit Panels	2.1	G												
			Soffit Panels	2.1.1	G												
			Flashing and Accessories	1.4.4	G												
			Gutter/Downspout Assembly	1.4.4	G												
			Snow Retention System	2.4.1.1	G												
			Snow Retention System	2.4.1.1	G												
			Snow Retention System	2.4.1.1	G												
			SD-03 Product Data														
			Roof Panels	2.1.1	G												
			Roof Panels	2.1.1	G												
			Roof Panels	2.4.1.1	G												
			Soffit Panels	2.1	G												
			Soffit Panels	2.1.1	G												
			Snow Retention System	2.4.1.1	G												
			Snow Retention System	2.4.1.1	G												
			Snow Retention System	2.4.1.1	G												
			Heat Island Reduction	2.2.2	S												
			Factory-Applied Color Finish	1.4.4	G												

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		07 41 13	Accessories	2.4													
			Fasteners	1.4.4													
			Pressure Sensitive Tape	1.4.4													
			Underlayments	2.7	G												
			Gaskets and Sealing/Insulating	2.8													
			Compounds														
			Coil Stock	1.4.4	G												
			SD-04 Samples														
			Roof Panels	2.1.1													
			Roof Panels	2.1.1													
			Roof Panels	2.4.1.1													
			Soffit Panels	2.1	G												
			Soffit Panels	2.1.1	G												
			Snow Retention System	2.4.1.1	G												
			Snow Retention System	2.4.1.1	G												
			Snow Retention System	2.4.1.1	G												
			Factory-applied Color Finish	1.4.4	G												
			Accessories	2.4													
			Fasteners	1.4.4													
			Gaskets and Sealant/Insulating	1.4.4													
			Compounds														
			SD-05 Design Data														
			Engineering Calculations	1.4.5	G												
			Wind Uplift Resistance	1.2.1.2	G												
			SD-06 Test Reports														
			Leakage Test Report	1.2.1.1	G												

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		07 41 13	Wind Uplift Test Report	1.2.1.2	G												
			Factory Finish and Color	2.2	G												
			Performance Requirements														
			SD-07 Certificates														
			Roof Panels	2.1.1	G												
			Roof Panels	2.1.1	G												
			Roof Panels	2.4.1.1	G												
			Coil Stock Compatibility	1.4.4													
			Self-Adhering Modified Bitumen	2.7.1	G												
			Underlayment														
			Qualification of Manufacturer	1.4.1													
			Qualification of Applicator	1.4.2													
			EPD	1.3.1.2	S												
			Recycled Content	1.3.1.3	S												
			Recycled Content	2.1.1	S												
			Regional Material	1.3.1.3	S												
			SD-08 Manufacturer's Instructions														
			Insulation	2.6													
			Installation Manual	1.4.4													
			SD-09 Manufacturer's Field														
			Reports														
			Manufacturer's Field Inspection	3.10.1	G												
			Reports														
			SD-11 Closeout Submittals														
			Warranties	1.8													
			Information Card	3.11													

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		07 41 13	Date Of Installation Wall-Mounted Placard	3.12													
		07 42 13	SD-01 Preconstruction Submittals														
			Qualification of Manufacturer	1.5.3													
			Qualification of Installation	1.5.4													
			Contractor														
			Warranties	1.8													
			SD-02 Shop Drawings														
			Installation Drawings	1.5.1.1	G												
			SD-03 Product Data														
			Wall Panels	2.2.1	G												
			Factory-Applied Color Finish	2.2.2	G												
			Closure Materials	1.5.5													
			Pressure Sensitive Tape	2.5.4.4													
			Sealants and Caulking	2.5.4.1													
			Galvanizing Repair Paint	1.5.3.1													
			Accessories	1.5.5													
			Accessories	2.5													
			SD-04 Samples														
			Wall Panels	2.2.1	G												
			Metal Closure Strips	2.5.3	G												
			SD-05 Design Data														
			Wind load design analysis	1.5.1.2	G												
			SD-06 Test Reports														
			Leakage Tests	3.7.2	G												
			Wind Load Tests	1.3.2	G												

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		07 42 13	Coating	2.2.2.6													
			Chalking	2.2.2.6													
			SD-07 Certificates														
			Coil Stock	1.5.3.1													
			Fasteners	1.5.3.1													
			EPD	1.4.1.1	S												
			Recycled Content	1.4.1.2	S												
			Recycled Content	2.1	S												
			Regional Material	1.4.1.2	S												
			SD-08 Manufacturer's Instructions														
			Installation	3.3													
			SD-09 Manufacturer's Field														
			Reports														
			Manufacturer's Field Reports	3.8.1	G												
			SD-11 Closeout Submittals														
			Warranties	1.8													
			Maintenance Instructions	1.5.6													
		07 52 00	SD-02 Shop Drawings														
			Roof Plan	1.4.5	G												
			Field Inspection and Existing	1.4.5													
			Conditions Report														
			SD-03 Product Data														
			Modified Bitumen Sheets	2.2	G												
			Heat Island Reduction	2.1.1	S												
			Cold-Applied Membrane	2.4	G												
			Adhesive														

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		07 52 00	Primer	2.6	G												
			Modified Bitumen Roof Cement	2.7	G												
			Pre-Manufactured Accessories	2.10													
			Fasteners And Plates	2.9	G												
			Warranty	1.8	G												
			SD-05 Design Data														
			Wind Uplift Calculations	1.4.4	G												
			SD-07 Certificates														
			Qualification of Manufacturer	1.4.1													
			Qualification of Applicator	1.4.2													
			Qualification of Engineer of	1.4.3													
			Record														
			Wind Uplift Resistance	1.4.4	G												
			SD-08 Manufacturer's Instructions														
			Modified Bitumen Membrane	3.3.5	G												
			Application														
			Flashing	3.3.6	G												
			Cold Adhesive Applied Modified	3.3.3.1	G												
			Bitumen Membrane														
			Primer	2.6													
			Fasteners	2.9.1													
			Cold Weather Installation	1.6	G												
			SD-09 Manufacturer's Field														
			Reports														
			Manufacturer's Field Inspection	3.6.1.1	G												
			Reports														

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		07 52 00	SD-11 Closeout Submittals														
			Warranty	1.8													
			Information Card	3.9													
			Instructions To Government Personnel	3.8													
		07 60 00	SD-02 Shop Drawings														
			Exposed Sheet Metal	2.2.1	G												
			Gravel Stops and fascia	2.2.1	G												
			Base Flashing	3.1.10	G												
			Counterflashing	3.1.11	G												
			Flashing at Roof Penetrations and Equipment Supports	3.1.18	G												
			Reglets	2.2.7	G												
			Copings	3.1.20	G												
			Drip Edges	3.1.15	G												
			Eave Flashing	3.1.16	G												
			Recycled Content	1.3.1.2	S												
			Recycled Content	2.1	S												
			SD-04 Samples														
			Finish Samples	1.4.2	G												
			SD-07 Certificates														
			EPD	1.3.1.1	S												
			Recycled Content	1.3.1.2	S												
			Recycled Content	2.1	S												
			Regional Material	1.3.1.2	S												
			SD-08 Manufacturer's Instructions														

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		07 60 00	Instructions for Installation	1.4.3	G												
			Quality Control Plan	3.5	G												
			SD-10 Operation and Maintenance Data														
			Cleaning and Maintenance	1.4.3	G												
		07 84 00	SD-02 Shop Drawings														
			Firestopping System	2.1	G												
			SD-03 Product Data														
			Firestopping Materials	2.2	G												
			SD-06 Test Reports														
			Inspection	3.3	G												
			SD-07 Certificates														
			EPD	1.4.1.1	S												
			Recycled Content	1.4.1.2	S												
			Regional Material	1.4.1.2	S												
			Inspector Qualifications	1.5.2	G												
			Firestopping Materials	2.2	G												
			Installer Qualifications	1.5.1	G												
		07 92 00	SD-03 Product Data														
			Sealants	2.1	G												
			Primers	2.2	G												
			Bond Breakers	2.3	G												
			Backstops	2.4	G												
			Field Adhesion	3.1	G												
			SD-07 Certificates														
			EPD	1.2.1.1	S												

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		07 92 00	VOC Emissions	1.2.1.2	S												
			VOC Content	1.2.1.2	S												
			Indoor Air Quality For Interior Sealants	2.1.1	S												
			Indoor Air Quality For Interior Floor Joint Sealants	2.1.3	S												
			Indoor Air Quality For Interior Acoustical Sealants	2.1.4	S												
			Indoor Air Quality For Interior Caulking	2.5	S												
		08 11 13	SD-02 Shop Drawings														
			Doors	2.1	G												
			Doors	2.1	G												
			Frames	2.5	G												
			Frames	2.5	G												
			Accessories	2.3													
			SD-03 Product Data														
			Doors	2.1	G												
			Frames	2.5	G												
			Accessories	2.3													
			SD-07 Certificates														
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Recycled Content	2.1	S												
			Recycled Content	2.5	S												
			Regional Material	1.2.1.2	S												

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		08 11 13	VOC Emissions	1.2.1.3	S												
		08 11 16	SD-02 Shop Drawings														
			Door and Frame Assembly	1.5.1	G												
			SD-03 Product Data														
			Door and Frame Assembly	1.5.1	G												
			SD-04 Samples														
			Finish Samples	1.5.2	G												
			Air Infiltration	1.2.2	G												
			Water Penetration	1.2.3	G												
			EPD	1.3.1.1	S												
			Recycled Content	1.3.1.2	S												
			Recycled Content	2.2.3	S												
			Regional Material	1.3.1.2	S												
			VOC Emissions	1.3.1.3	S												
			NFRC Project Label Certificates for Fenestration	1.2.4	G												
			SD-08 Manufacturer's Instructions														
			Door and Frame Assembly	1.5.1	G												
			Adjustments, Cleaning, and Maintenance	1.5.3													
			NFRC Project Label Certificates for Fenestration	1.2.4	G												
		08 14 00	SD-02 Shop Drawings														
			Doors	2.1	G												
			SD-03 Product Data														
			Doors	2.1	G												

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		08 14 00	Accessories	2.2													
			Water-resistant Sealer	2.3.7													
			Warranty	1.5													
			Sound Transmission Class	2.1.2	G												
			Rating														
			Fire Resistance Rating	2.1.3	G												
			SD-04 Samples														
			Door Finish Color	2.3.6.2	G												
			SD-06 Test Reports														
			Cycle-Slam	2.4													
			Hinge Loading Resistance	2.4													
			SD-07 Certificates														
			Certificates of Grade	1.3.1													
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Recycled Content	2.1.1.1	S												
			Regional Material	1.2.1.2	S												
			Certified Sustainably Harvested	2.1.1	S												
			Flush Wood Doors														
			Indoor Air Quality for	2.1.1.1	S												
			Particleboard and Agrifiber Door														
			Cores														
			SD-11 Closeout Submittals														
			Warranty	1.5													
		08 31 00	SD-02 Shop Drawings														
			Access Doors And Panels	1.4	G												

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		08 31 00	SD-03 Product Data														
			Access Doors And Panels	1.4	G												
			Hardware	1.4.2	G												
			Accessories	2.2.8	G												
			SD-04 Samples														
			Finishes	2.5	G												
			SD-07 Certificates														
			Recycled Content	1.3.1	S												
			Recycled Content	2.1	S												
			Regional Material	1.3.1	S												
		08 32 13	SD-02 Shop Drawings														
			Sliding Glass Doors	2.1													
			SD-03 Product Data														
			Hardware	2.1.1													
			Glazing	2.1.2													
			SD-04 Samples														
			Glazing	2.1.2													
			Hardware	2.1.1													
			SD-07 Certificates														
			EPD	1.1.1.1	S												
			Recycled Content	1.1.1.2	S												
			Regional Material	1.1.1.2	S												
			VOC Emissions	1.1.1.3	S												
		08 33 23	SD-02 Shop Drawings														
			Overhead Coiling Doors	2.2.1	G												
			Counterbalancing Mechanism	2.2.3	G												

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		08 33 23	Electric Door Operators	2.2.4	G												
			Bottom Bars	2.2.1.3	G												
			Guides	2.1.1.1	G												
			Mounting Brackets	2.2.3.1	G												
			Hood	2.2.2.2	G												
			Installation Drawings	2.1.1.1													
			SD-03 Product Data														
			Overhead Coiling Doors	2.2.1	G												
			Hardware	2.2.2	G												
			Counterbalancing Mechanism	2.2.3	G												
			Electric Door Operators	2.2.4	G												
			SD-05 Design Data														
			Overhead Coiling Doors	2.2.1	G												
			Hardware	2.2.2	G												
			Counterbalancing Mechanism	2.2.3	G												
			Electric Door Operators	2.2.4	G												
			SD-07 Certificates														
			EPD	1.3.1	S												
			VOC Emissions	1.3.3	S												
			Recycled Content	1.3.2	S												
			Regional Material	1.3.2	S												
			SD-10 Operation and Maintenance														
			Data														
			Operation and Maintenance	1.4.2	G												
			Manuals														
			SD-11 Closeout Submittals														

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		08 33 23	Warranty	1.4.1													
		08 34 73	SD-02 Shop Drawings														
			Fabrication Drawings	2.1													
			SD-03 Product Data														
			Hollow Metal Sound Retardant Doors	2.1	G												
			Wood Sound Retardant Doors	2.1	G												
			Door Frames	2.1	G												
			Door Hardware	2.1	G												
			Door Frame Sound Infill	2.3.2	G												
			Vision Panels	2.1	G												
			Intumescent Seals and Gasketing	2.1	G												
			Thresholds	2.1	G												
			SD-06 Test Reports														
			Acoustical Tests	2.4.4	G												
			Air Infiltration Tests	2.4.4	G												
			Positive Pressure Tests	2.4.4	G												
			SD-07 Certificates														
			Hollow Metal Sound Retardant Doors	2.1	G												
			Wood Sound Retardant Doors	2.1	G												
			Door Frames	2.1	G												
			Door Hardware	2.1	G												
			Vision Panels	2.1	G												
			Intumescent Seals,Gasketing and	1.4.1.3	G												
			Door Bottoms														

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		08 34 73	Thresholds	2.1													
			Assembly Test Reports	3.3.1													
			EPD	1.3.1	S												
			Recycled Content	1.3.2	S												
			Regional Material	1.3.2	S												
			Forest Stewardship Council (FSC) Certification	1.3.2	S												
			VOC Emissions	1.3.3	S												
			Formaldehyde Emissions	1.3.3	S												
			Legal Wood	1.3.4	S												
		08 51 13	SD-02 Shop Drawings														
			Windows	2.1	G												
			Fabrication Drawings	1.7													
			SD-03 Product Data														
			Windows	2.1	G												
			Fasteners	2.2.2	G												
			Window Performance	1.8	G												
			Thermal-Barrier Windows	2.3	G												
			Mullions	2.4	G												
			Window Cleaners' Bolts	2.5	G												
			Accessories	2.2.6	G												
			Adhesives	2.2.3													
			Thermal Performance	1.8.4	G												
			SD-04 Samples														
			Finish Sample	1.3.3.1													
			Mock-Ups	1.3.3.2	G												

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		08 51 13	SD-05 Design Data														
			Structural Calculations for	2.1	G												
			Deflection														
			Design Analysis	1.3.4	G												
			SD-06 Test Reports														
			Minimum Condensation	1.3.5													
			Resistance Factor														
			Windborne-Debris-Impact	1.8.6													
			Performance														
			SD-07 Certificates														
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Recycled Content	2.1	S												
			Regional Material	1.2.1.2	S												
			VOC Emissions	1.2.1.3	S												
			SD-10 Operation and Maintenance														
			Data														
			Windows	2.1													
			Plastic Identification	1.5													
		08 71 00	SD-02 Shop Drawings														
			Manufacturer's Detail Drawings	1.4	G												
			Verification of Existing Conditions	1.4	G												
			Hardware Schedule	1.6	G												
			Keying System	2.3.10	G												
			SD-03 Product Data														
			Hardware Items	2.3	G												

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		08 71 00	SD-07 Certificates														
			EPD	1.3.1	S												
			Recycled Content	1.3.2	S												
			Regional Material	1.3.2	S												
			SD-08 Manufacturer's Instructions														
			Installation	3.1													
			SD-10 Operation and Maintenance														
			Data														
			Hardware Schedule	1.6	G												
			SD-11 Closeout Submittals														
			Key Bitting	1.7.1													
		08 81 00	SD-03 Product Data														
			Insulating Glass	2.2													
			Glazing Accessories	1.3													
			Sealants	2.3.3.1													
			Joint Backer	2.3.4													
			SD-04 Samples														
			Insulating Glass	2.2													
			Glazing Compound	2.3.2													
			Tape	2.3.6													
			Sealing Tapes	2.3.6													
			SD-07 Certificates														
			Insulating Glass	2.2													
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Regional Material	1.2.1.2	S												

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		08 81 00	SD-08 Manufacturer's Instructions														
			Setting and Sealing Materials	2.3													
			Glass Setting	3.2													
			SD-11 Closeout Submittals														
			Insulated Glass Units	1.7.1													
			Monolithic Opacified Spandrel	1.7.2													
		08 91 00	SD-02 Shop Drawings														
			Wall Louvers	1.5	G												
			SD-03 Product Data														
			Metal Wall Louvers	2.2	G												
			SD-04 Samples														
			Wall Louver Samples	1.6	G												
			SD-07 Certificates														
			EPD	1.3.1	S												
			Recycled Content	1.3.2	S												
			Regional Material	1.3.2	S												
			VOC Emissions	1.3.3	S												
		09 22 00	SD-02 Shop Drawings														
			Metal Support Systems	2.1	G												
			SD-03 Product Data														
			Metal Support Systems	2.1													
			Recycled Content	1.3.1	S												
			Recycled Content	2.1	S												
			Regional Material	1.3.1	S												
		09 29 00	SD-03 Product Data														
			Cementitious Backer Units	2.1.6													

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		09 29 00	Water-Resistant Gypsum Backing Board	2.1.3													
			Glass Mat Covered or Reinforced Gypsum Sheathing	2.1.4													
			Glass Mat Covered or Reinforced Gypsum Sheathing Sealant	2.1.4.1													
			Accessories	2.1.10													
			Gypsum Board	2.1.1													
			Recycled Content for Gypsum Board	2.1.1	S												
			Recycled Content for Paper Facing and Gypsum Cores	2.1.1	S												
			SD-06 Test Reports														
			ASTM E90 Factory Test Report	2.1.5.1	G												
			ASTM E90 Factory Test Report	3.7	G												
			ASTM E90 Factory Test Report	3.10	G												
			ASTM E336 Field Test Report	3.10	G												
			SD-07 Certificates														
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Regional Material	1.2.1.2	S												
			VOC Emissions	1.2.1.3	S												
			VOC Emissions	2.1	S												
			VOC Emissions	2.1.7	S												
			Asbestos Free Materials	2.1	G												
			SD-08 Manufacturer's Instructions														

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		09 29 00	Safety Data Sheets	2.1													
			SD-10 Operation and Maintenance Data														
			Manufacturer Maintenance Instructions	2.1													
		09 30 10	SD-02 Shop Drawings														
			Detail Drawings	3.2	G												
			SD-03 Product Data														
			Porcelain Tile	2.1.1	G												
			Recycled Content for Porcelain Tile	2.1.1	S												
			Glazed Ceramic Wall Tile	2.1.4	G												
			Recycled Content for Glazed Ceramic Wall Tile	2.1.4	S												
			Transition Strips	2.1													
			Metal Strips	2.6.1													
			Setting-Bed	2.2	G												
			Mortar, Grout, and Adhesive	2.4	G												
			Reinforcing Wire Fabric														
			SD-04 Samples														
			Tile	2.1	G												
			Transition Strips	2.1	G												
			Metal Strips	2.6.1	G												
			Grout	2.4.2	G												
			SD-07 Certificates														
			EPD	1.2.1.1	S												

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		09 30 10	Recycled Content	1.2.1.2	S												
			Regional Material	1.2.1.2	S												
			VOC Emissions	1.2.1.3	S												
			Indoor Air Quality for Adhesives	2.4	S												
			Indoor Air Quality for Sealants		S												
			SD-08 Manufacturer's Instructions														
			Manufacturer's Approved	3.6													
			Cleaning Instructions														
			SD-10 Operation and Maintenance														
			Data														
			Porcelain Tile	2.1.1	G												
			Glazed Ceramic Wall Tile	2.1.4	G												
		09 51 00	SD-02 Shop Drawings														
			Approved Detail Drawings	2.1	G												
			SD-03 Product Data														
			Acoustical Ceiling Systems	2.1	G												
			Acoustical Performance	2.1.1	G												
			SD-04 Samples														
			Acoustical Units	2.2	G												
			SD-07 Certificates														
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Recycled Content	2.2.1.1	S												
			Recycled Content	2.3	S												
			Regional Material	1.2.1.2	S												
			FSC Certification	1.2.1.2	S												

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		09 51 00	FSC Certification	2.2.4.1	S												
			VOC Emissions	1.2.1.3	S												
			Formaldehyde Emissions	1.2.1.3	S												
			Legal Wood	1.2.1.4	S												
			SD-10 Operation and Maintenance Data														
			Take-Back Program	1.2.1.2	S												
		09 65 00	SD-02 Shop Drawings														
			Resilient Flooring and Accessories	2.10	G												
			SD-03 Product Data														
			Resilient Flooring and Accessories	2.10	G												
			Adhesives	2.6													
			Luxury Vinyl Tile	2.2	G												
			Recycled content for Luxury Vinyl Tile	2.2	S												
			Rubber Tile	2.1	G												
			Wall Base	2.3	G												
			Stair Treads, Risers and Stringers	2.4	G												
			SD-04 Samples														
			Resilient Flooring and Accessories	2.10	G												
			SD-06 Test Reports														

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		09 65 00	Moisture, Alkalinity and Bond Tests	3.3	G												
			SD-07 Certificates														
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Regional Material	1.2.1.2	S												
			VOC Emissions	1.2.1.3	S												
			Indoor Air Quality for Rubber Tile	2.1	S												
			Indoor Air Quality for Luxury Vinyl Tile	2.2	S												
			Indoor Air Quality for Adhesives	2.6	S												
			SD-08 Manufacturer's Instructions														
			Surface Preparation	3.2													
			Installation	3.1													
			SD-10 Operation and Maintenance Data														
			Resilient Flooring and Accessories	2.10													
		09 67 23.13	SD-02 Shop Drawings														
			Installation Drawings	2.1													
			SD-03 Product Data														
			Manufacturer's Catalog Data	1.2.2	G												
			SD-04 Samples														
			Hardboard Mounted Epoxy Flooring	1.6.2	G												
			Floor Topping	3.1.4	G												

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		09 67 23.13	SD-05 Design Data														
			Design Mix Data	1.2.3	G												
			SD-07 Certificates														
			EPD	1.4.1	S												
			Recycled Content	1.4.2	S												
			Regional Material	1.4.2	S												
			VOC Emissions	1.4.3	S												
			Listing of Product Installations	1.6.1													
			Referenced Standards	1.6													
			Certificates														
			SD-11 Closeout Submittals														
			Warranty	1.7	G												
		09 67 23.15	SD-03 Product Data														
			Joint Sealant		G												
			Thin Film Flooring System	2.2	G												
			White Aluminum Oxide Non-Skid		G												
			Grit														
			SD-05 Design Data														
			Environmental Control System	1.4.3.1													
			SD-06 Test Reports														
			Joint Sealant Test Report	1.4.4.1	G												
			Primer Coat	2.2.1	G												
			Urethane Topcoat	2.2.2	G												
			Patch Test Demonstration	1.8	G												
			Daily Inspection Report	1.4.4.2	G												
			Adhesion Testing	3.8.3	G												

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		09 67 23.15	SD-07 Certificates														
			EPD	1.3.1	S												
			Recycled Content	1.3.2	S												
			Regional Material	1.3.2	S												
			VOC Emissions	1.3.3	S												
			Coating Work Plan	1.4.2	G												
			Joint Sealant Certificates	1.4.5.5	G												
			Thin Film Flooring System	1.4.5.6	G												
			Certificates														
			Qualifications of Certified	1.4.5.1													
			Industrial Hygienist (CIH)														
			Qualifications of Certified	1.4.1													
			Protective Coatings Specialist														
			(PCS)														
			Qualifications of Coating	1.4.5.2													
			Inspection Company														
			Qualifications of QC Specialist	1.4.5.3													
			Coating Inspector														
			Qualifications of Coating	1.4.5.4	G												
			Contractors														
			Warranty	1.9	G												
			SD-08 Manufacturer's Instructions														
			Joint Sealant Manufacturer's	1.4.6.1	G												
			Instructions														
			Thin Film Flooring System	1.4.6.2	G												
			Manufacturer's Instructions														

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		09 67 23.15	Water-Based Alkaline Degreaser	1.4.6.3	G												
			SD-11 Closeout Submittals														
			Inspection Logbook	3.8.2.2	G												
		09 68 00	SD-02 Shop Drawings														
			Installation Drawings	3.4	G												
			SD-03 Product Data														
			Carpet	2.1	G												
			Recycled Content for Carpeting	2.1.1	S												
			Moldings	2.4	G												
			SD-04 Samples														
			Carpet	2.1	G												
			Moldings	2.4													
			SD-06 Test Reports														
			Moisture and Alkalinity Tests	3.2													
			SD-07 Certificates														
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Regional Material	1.2.1.2	S												
			VOC Emissions	1.2.1.3	S												
			Indoor Air Quality for Carpet	2.1.2	S												
			SD-08 Manufacturer's Instructions														
			Surface Preparation	3.1													
			SD-10 Operation and Maintenance														
			Data														
			Cleaning and Protection	3.5													
			Maintenance Service	3.7.2													

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		09 68 00	Take-Back Program	3.7.2	S												
			SD-11 Closeout Submittals														
			Warranty	1.5													
		09 72 00	SD-03 Product Data														
			Wallcoverings and Accessories	2.1	G												
			Primer and Adhesive	2.3													
			SD-04 Samples														
			Wallcoverings and Accessories	2.1	G												
			SD-07 Certificates														
			EPD	1.3.1	S												
			Recycled Content	1.3.2	S												
			Regional Material	1.3.2	S												
			VOC Emissions	1.3.3	S												
			SD-08 Manufacturer's Instructions														
			Wallcoverings and Accessories	2.1													
			SD-10 Operation and Maintenance														
			Data														
			Wallcoverings and Accessories	2.1													
		09 84 20	SD-02 Shop Drawings														
			Approved Detail Drawings	2.2	G												
			SD-03 Product Data														
			Installation	3.2													
			Acoustical Wall Panels	2.2	G												
			Recycled Content for Fabric	2.1.1.1	S												
			Panels														
			SD-04 Samples														

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		09 84 20	Acoustical Wall Panels	2.2													
			SD-07 Certificates														
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Regional Material	1.2.1.2	S												
			VOC Emissions	1.2.1.3	S												
			Acoustical Wall Panels	2.2													
			SD-11 Closeout Submittals														
			Warranty	1.4													
		09 90 00	SD-02 Shop Drawings														
			Piping Identification	3.10													
			SD-03 Product Data														
			Coating	2.1	G												
			Product Data Sheets	2.1													
			SD-04 Samples														
			Color	2.3	G												
			SD-07 Certificates														
			Qualification Testing	1.6.5.2	G												
			EPD	1.5.1.1	S												
			VOC Emissions	1.5.1.3	S												
			VOC Emissions	1.6.4	S												
			VOC Content	1.5.1.3	S												
			VOC Content	1.6.4	S												
			SD-08 Manufacturer's Instructions														
			Mixing	2.1													

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		09 90 00	Manufacturer's Safety Data	1.8.1													
			Sheets														
			SD-10 Operation and Maintenance														
			Data														
			Take-Back Program	1.5.1.2	S												
			Coatings	2.1	G												
		09 97 13.26	SD-07 Certificates														
			Epoxy-Polyamide	2.1.1.1	G												
		10 14 00.10	SD-02 Shop Drawings														
			Approved Detail Drawings	3.1	G												
			SD-03 Product Data														
			Installation	3.1													
			Exterior Signage	1.2	G												
			Exterior Signage	2.1	G												
			SD-04 Samples														
			Exterior Signage	1.2	G												
			Exterior Signage	2.1	G												
			Exterior Signage Mounting	2.1.1.3	G												
			Calculations														
			Illuminance	2.2.1	G												
			SD-10 Operation and Maintenance														
			Data														
			Protection and Cleaning	3.1.2	G												
		10 14 00.20	SD-02 Shop Drawings														
			Detail Drawings	1.4.2	G												
			SD-03 Product Data														

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		10 14 00.20	Room Identification And Directional Signage System	2.1	G												
			Stair Signage	2.2	G												
			Building Directories	2.3	G												
			SD-04 Samples														
			Interior Signage	1.4.1	G												
			Software	1.3	G												
			Room Identification And Directional Signage System	2.1	G												
			Stair Signage	2.2	G												
			Building Directories	2.3	G												
			SD-10 Operation and Maintenance Data														
			Approved Manufacturer's Instructions	3.1	G												
			Protection and Cleaning	3.1.2	G												
		10 21 13	SD-02 Shop Drawings														
			Fabrication Drawings	2.1													
			Installation Drawings	3.2	G												
			SD-03 Product Data														
			Cleaning and Maintenance Instructions	2.1													
			Colors And Finishes	2.7													
			Anchoring Devices and Fasteners	2.2.2													
			Hardware and Fittings	2.2.4													
			Brackets	2.2.3													

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		10 21 13	Door Hardware	2.2.5													
			Toilet Enclosures	2.3.1													
			Pilaster Shoes	2.5													
			Finishes	2.2.4.2	G												
			Finishes	2.7.2	G												
			SD-04 Samples														
			Colors and Finishes	2.7	G												
			Hardware and Fittings	2.2.4													
			Anchoring Devices and Fasteners	2.2.2													
			SD-07 Certificates														
			Warranty	1.6													
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Recycled Content	2.3	S												
			Regional Material	1.2.1.2	S												
			VOC Emissions	1.2.1.3	S												
			SD-10 Operation and Maintenance														
			Data														
			Plastic Identification	2.1.1	G												
		10 26 00	SD-02 Shop Drawings														
			Corner Guards	2.2	G												
			Wall Covering and Panels	2.3	G												
			SD-03 Product Data														
			Corner Guards	2.2	G												
			Wall Covering and Panels	2.3	G												

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		10 26 00	Recycled content for aluminum component of corner guards	2.2.1	S												
			Recycled content for steel component of corner guards	2.2.2	S												
			SD-04 Samples														
			Corner Guards	2.2	G												
			Wall Covering and Panels	2.3	G												
			SD-06 Test Reports														
			Fire Resistance Rating	2.1.1.2													
			SD-07 Certificates														
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Regional Material	1.2.1.2	S												
			VOC Emissions	1.2.1.3	S												
			Indoor air quality for wall covering/panels	2.3	S												
			Indoor air quality for adhesives	2.4	S												
		10 28 13	SD-02 Shop Drawings														
			Product Schedule	2.1	G												
			SD-03 Product Data														
			Recycled content for stainless steel toilet accessories	2.1	S												
			Bench, Stall, Shower, Built-In	2.1.3	G												
			Disposal, Sanitary Napkin, SS, Surface Mounted	2.1.6	G												

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		10 28 13	Grab Bar, 1-1/4 inch Diameter, SS, 2 Wall, W/C Accessible	2.1.7	G												
			Grab Bar, 1-1/4 inch Diameter, SS, 2 Wall, Shower Use	2.1.8	G												
			Shelf, Utility W/ Mop/Broom Holders, SS, Surface Mounted	2.1.9	G												
			Hook, Towel, Double, SS, Surface Mounted	2.1.10	G												
			Rod, Shower	2.1.11	G												
			Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mounted	2.1.12	G												
			Automatic Soap Dispenser	2.1.4	G												
			Automatic Dispenser, Paper Towel, and Waste Receptacle, SS	2.1.5	G												
			Automatic Dispenser, Paper Towel, and Waste Receptacle, SS	2.1.5	G												
			Mirrors	2.1.13													
			SD-07 Certificates														
			EPD	1.3.1	S												
			Recycled Content	1.3.2	S												
			Regional Material	1.3.2	S												
			SD-10 Operation and Maintenance Data														
			Automatic Soap Dispenser	2.1.4	G												
			Automatic Dispenser, Paper Towel, And Waste Receptacle, SS	2.1.5	G												

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		10 28 13	Automatic Dispenser, Paper Towel, And Waste Receptacle, SS	2.1.5	G												
		10 44 16	SD-02 Shop Drawings														
			Cabinets	Part 2	G												
			Wall Brackets	2.1.2	G												
			Schedule	1.4	G												
			SD-03 Product Data														
			Cabinets	Part 2	G												
			Wall Brackets	2.1.2	G												
			Replacement Parts List	3.2.1													
		10 51 13	SD-02 Shop Drawings														
			Types	2.1	G												
			Location	1.5	G												
			Installation	3.1													
			SD-03 Product Data														
			Material	2.2													
			SD-04 Samples														
			Color chips	1.6.1	G												
			SD-07 Certificates														
			EPD	1.3.1	S												
			Recycled Content	1.3.2	S												
			Regional Material	1.3.2	S												
		10 56 13	SD-01 Preconstruction Submittals														
			Shelving Units	2.1													
			SD-03 Product Data														
			Shelving Units	2.1													

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		10 56 13	Installation instructions	3.2													
			SD-04 Samples														
			Finish	2.2													
			SD-06 Test Reports														
			Shelving Units	2.1													
			Finish	2.2													
			SD-07 Certificates														
			EPD	1.4.1	S												
			Recycled Content	1.4.2	S												
			Regional Material	1.4.2	S												
		11 11 37	SD-02 Shop Drawings														
			Cords	2.2.3	G												
			Level 2 Pedestal Mounted EVSE	2.2.2.1	G												
			SD-03 Product Data														
			Cords	2.2.3	G												
			Level 2 Pedestal Mounted EVSE	2.2.2.1	G												
			SD-07 Certificates														
			Qualifications	1.6.2.1	G												
			Certified Installers	1.2.2	G												
			SD-08 Manufacturer's Instructions														
			Cords	2.2.3	G												
			Level 2 Pedestal Mounted EVSE	2.2.2.1	G												
			SD-09 Manufacturer's Field														
			Reports														
			Testing of Electric Vehicle Supply	3.8.1	G												
			Equipment														

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		11 11 37	SD-10 Operation and Maintenance Data														
			Electric Vehicle Supply Equipment	2.2													
			SD-11 Closeout Submittals														
			Warranty	1.7	G												
			Record Documentation	3.7													
		12 24 13	SD-02 Shop Drawings														
			Detailed Drawings	3.2	G												
			SD-03 Product Data														
			Window Shades	2.1	G												
			SD-04 Samples														
			Window Shades	2.1	G												
			SD-06 Test Reports														
			Flammability Requirements	1.3.2	G												
			SD-07 Certificates														
			EPD	1.2.1.1	S												
			Recycled Content	1.2.1.2	S												
			Regional Material	1.2.1.2	S												
			VOC Emissions	1.2.1.3	S												
			Qualifications	1.3.1.1													
			SD-10 Operation and Maintenance Data														
			Window Shades	2.1	G												
		12 48 13	SD-02 Shop Drawings														
			Installation Drawings	3.2	G												

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		12 48 13	Detail Drawings	3.2	G												
			SD-03 Product Data														
			Entrance Floor Mats and Frames	2.1.1	G												
			Adhesives and Concrete Primers	2.1.2	G												
			SD-04 Samples														
			Entrance Floor Mats and Frames	2.1.1	G												
			SD-07 Certificates														
			EPD	1.3.1.1	S												
			Recycled Content	1.3.1.2	S												
			Regional Material	1.3.1.2	S												
			VOC Emissions	1.3.1.3	S												
			SD-08 Manufacturer's Instructions														
			Manufacturer's Instructions	3.2													
			SD-10 Operation and Maintenance														
			Data														
			Protection, Maintenance, and	3.2													
			Repair Information														
		12 93 00	SD-02 Shop Drawings														
			Benches	2.5	G												
			Shelters	2.8	G												
			Assembly Instruction Drawings	1.3.3													
			SD-03 Product Data														
			Benches	2.5													
			Shelters	2.8													
			Flagpole	2.7													

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		12 93 00	Recycled Content for steel components	2.1.1	S												
			Recycled Content for aluminum components	2.1.3	S												
			Waste Receptacles	2.6													
			SD-04 Samples														
			Finish	2.3.4	G												
			SD-06 Test Reports														
			Testing	3.3													
			SD-07 Certificates														
			Primer Certificate	1.3.4													
			Powder Coatings Certificate	1.3.5													
		13 21 26	SD-02 Shop Drawings														
			Cold-Storage Rooms	2.1	G												
			SD-03 Product Data														
			Cold-Storage Rooms	2.1	G												
			Shelves	2.2	G												
			Refrigeration Equipment	2.3	G												
			Energy Star Label For	2.3	S												
			Refrigeration Equipment														
			SD-06 Test Reports														
			Tests	3.3	G												
			Flame Spread and Smoke Index	2.1.1	G												
			SD-08 Manufacturer's Instructions														
			Cold-Storage Rooms	2.1													
			Refrigeration Equipment	2.3													

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		13 21 26	SD-10 Operation and Maintenance Data														
			Cold-Storage Rooms	2.1	G												
			Refrigeration Equipment	2.3	G												
			SD-11 Closeout Submittals														
			Operating Instructions	3.4	G												
		13 22 00	SD-02 Shop Drawings														
			Hazmat Container	2.1	G												
			SD-03 Product Data														
			Hazmat Container	2.1	G												
			SD-08 Manufacturer's Instructions														
			Hazmat Container	2.1	G												
			SD-10 Operation and Maintenance Data														
			Hazmat Container	2.1	G												
		13 34 19	SD-01 Preconstruction Submittals														
			Manufacturer's Qualifications	1.6.3	G												
			SD-02 Shop Drawings														
			Detail Drawings	1.6.1	G												
			Erection Plan	1.2.10													
			SD-03 Product Data														
			Manufacturer's Catalog Data	1.6.1	G												
			Recycled Content for Structural Steel Shapes and Plates	2.1.1	S												
			Recycled Content for Steel Pipe	2.1.2	S												

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		13 34 19	Recycled Content for Steel Sheet Materials	2.4.1	S												
			Recycled Content for Insulation Materials	2.8.3	S												
			SD-04 Samples														
			Roof Panels	1.6.1	G												
			Wall Panels	1.6.1	G												
			Color Chips	2.4.3													
			SD-05 Design Data														
			Manufacturer's Descriptive and Technical Literature	1.6.1	G												
			Manufacturer's Building Design Analysis	1.6.1	G												
			Lateral Force Calculations	1.6.1	G												
			SD-06 Test Reports														
			Test Reports	1.6.1													
			Coatings and Base Metals	1.6.1													
			Factory Color Finish Performance Requirements	1.6.1													
			SD-07 Certificates														
			System Components	1.6.1	G												
			Coil Stock Certificates	1.6.1	G												
			Aluminized Steel Repair Paint	1.6.1	G												
			Galvanizing Repair Paint	1.6.1	G												
			Enamel Repair Paint	1.6.1	G												
			Qualification of Manufacturer	1.6.1													

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		13 34 19	Qualification of Erector	1.6.1													
			SD-08 Manufacturer's Instructions														
			Installation of Roof and Wall panels	1.6.2													
			Shipping, Handling, and Storage	1.7													
			SD-11 Closeout Submittals														
			Manufacturer's Warranty	3.13.1													
			Contractor's Warranty for Installation	3.13.2													
		13 48 73	SD-02 Shop Drawings														
			Bracing	3.1	G												
			Resilient Vibration Isolation Devices	3.4	G												
			Equipment Requirements	2.1	G												
			SD-03 Product Data														
			Bracing	3.1	G												
			Equipment Requirements	2.1	G												
			Anchor Bolts	3.3	G												
			Vibration Isolators	2.1.2	G												
			Snubbers	3.4.2	G												
			SD-05 Design Data														
			Design Calculations	1.2.4	G												
			SD-06 Test Reports														
			Anchor Bolts	3.3	G												
			SD-07 Certificates														
			ICC ES AC156 Shake Table Test	3.6	G												

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		14 24 23	SD-02 Shop Drawings														
			Elevator	2.1	G												
			Elevator Components	1.2.1	G												
			Elevator Components	1.2.2	G												
			Elevator Machine	1.2.1	G												
			Elevator Controller	1.2.1	G												
			Wiring Diagrams	1.3.4	G												
			SD-03 Product Data														
			Elevator	2.1	G												
			Elevator Components	1.2.1	G												
			Elevator Components	1.2.2	G												
			Data Sheets	1.2.2	G												
			Elevator Microprocessor Controller	2.5.2	G												
			SD-05 Design Data														
			Emergency Power Systems	1.2.3.3													
			Heat Loads	1.2.3.2													
			Reaction Loads	1.2.3.1													
			SD-07 Certificates														
			Price Lists	1.3.2	G												
			Warranty	1.4													
			Endorsement Letter	1.3.1.1													
			Welders' Qualifications	1.2.4													
			Elevator Controller Certification	2.5.2.3	G												
			SD-10 Operation and Maintenance Data														

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		14 24 23	Elevator	2.1	G												
			Maintenance Control Program (MCP)	1.2.5	G												
			Software and Documentation	2.5.2.2	G												
		21 12 00	SD-02 Shop Drawings														
			Pier Standpipe System	1.4.1	G												
			SD-03 Product Data														
			Pipe and Fittings	2.1.1	G												
			Pipe Hangers and Supports	2.1.2	G												
			Valves	2.1.3	G												
			Expansion Joints and Seismic Joints	2.1.6	G												
			Fire Department Connections	2.1.7	G												
			Buried Pipe and fittings	2.2.1	G												
			SD-06 Test Reports														
			Preliminary Tests	3.5.1	G												
			Acceptance Tests	3.5.2	G												
			SD-07 Certificates														
			Qualifications of Installer	1.6.1	G												
			SD-11 Closeout Submittals														
			System As-Built Drawings	1.6.2	G												
		21 13 13	SD-01 Preconstruction Submittals														
			Qualified Fire Protection Engineer (QFPE)	1.2.3	G												
			Sprinkler System Designer	1.4.2.1	G												
			Sprinkler System Installer	1.4.2.2	G												

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		21 13 13	SD-02 Shop Drawings														
			Shop Drawing	1.4.1.1	G												
			SD-03 Product Data														
			Pipe	2.2.1	G												
			Fittings	2.3.1.2	G												
			Valves	2.3.4	G												
			Relief Valves	2.8.5	G												
			Sprinklers	2.7	G												
			Pipe Hangers and Supports	2.3.3	G												
			Sprinkler Alarm Switch	2.4.1	G												
			Valve Supervisory (Tamper)	2.4.2	G												
			Switch														
			Fire Department Connection	2.6	G												
			Backflow Prevention Assembly	2.5	G												
			Air Vent	2.8.6	G												
			Hose Valve	2.5.1	G												
			Nameplates	2.1.2	G												
			SD-05 Design Data														
			Hydraulic Calculations	1.2.1.2	G												
			SD-06 Test Reports														
			Test Procedures	3.7.1	G												
			SD-07 Certificates														
			Verification of Compliant	3.7.2.1	G												
			Installation														
			Request for Government Final	3.7.2.2	G												
			Test														

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		21 13 13	SD-10 Operation and Maintenance Data														
			Operating and Maintenance (O&M) Instructions	3.9	G												
			Spare Parts	1.6	G												
			SD-11 Closeout Submittals														
			As-built drawings	3.9	G												
		21 22 00.00 40	SD-01 Preconstruction Submittals														
			Previous Product Installation	1.3.2	G												
			SD-02 Shop Drawings														
			High-Pressure Cylinders	2.1.4	G												
			Piping Materials	2.4.1	G												
			Pipe Hangers and Supports	2.4.1.1	G												
			Pressure Alarm Switch	2.4.3.1	G												
			Nozzle	2.1.2	G												
			Manual Actuation Station	2.4.6	G												
			Installation Drawings	2.1.1	G												
			SD-03 Product Data														
			Escutcheons	2.4.2	G												
			Storage Batteries	2.4.5.1.1	G												
			Battery Charger	2.4.5.1.2	G												
			Smoke Detectors	2.4.7	G												
			Audible Alarms	2.4.9.1	G												
			Visual Alarms	2.4.9.2	G												
			Main Annunciator	2.4.10	G												
			Pressure-Relief Device	3.1	G												

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		21 22 00.00 40	SD-05 Design Data														
			Design Analysis	2.1.2	G												
			Discharge Calculations	2.1.2	G												
			Relief Vent Sizing Calculation	3.1.1	G												
			SD-06 Test Reports														
			Test Procedure	3.2.2	G												
			Preliminary Tests	3.2.3	G												
			Formal Tests	3.2.4	G												
			Enclosure Fan Test	3.1.2	G												
			SD-07 Certificates														
			Certificates of Compliance	2.1													
			SD-10 Operation and Maintenance														
			Data														
			Operating Instructions	3.1.7	G												
			Operation and Maintenance	3.1.7	G												
			Manuals														
			SD-11 Closeout Submittals														
			Record Drawings	3.3.1	G												
		21 30 00	SD-01 Preconstruction Submittals														
			Fire Pump Installation Related	1.3													
			Submittals														
			Fire Protection Specialist	1.7.1	G												
			SD-02 Shop Drawings														
			Installation Drawings	3.3.1	G												
			As-Built Drawings	3.10.2	G												
			Piping Layout	3.3.2	G												

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/ REV W	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
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		21 30 00	Pump Room	3.3.2	G												
			SD-03 Product Data														
			Catalog Data	2.1	G												
			Spare Parts	1.6	G												
			Preliminary Tests	3.8.2	G												
			Field Tests	3.8	G												
			Manufacturer's Representative	1.7.6	G												
			Field Training	3.10.1	G												
			SD-06 Test Reports														
			Preliminary Tests	3.8.2	G												
			Navy Formal Inspection and Tests	3.8.3	G												
			SD-07 Certificates														
			Fire Protection Specialist	1.7.1	G												
			Qualifications of Welders	1.7.2	G												
			Qualifications of Installer	1.7.3	G												
			Preliminary Test Certification	1.7.4	G												
			Final Test Certification	1.7.5	G												
			SD-10 Operation and Maintenance Data														
			Operating and Maintenance Instructions	3.10.1	G												
			Flow Meter	2.12	G												
		22 00 00	SD-02 Shop Drawings														
			Plumbing System	3.9.1	G												
			SD-03 Product Data														

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		22 00 00	Recycled Content for Steel Pipe	2.1	G												
			Recycled Content for Cast Iron	2.1	G												
			Pipe														
			Fixtures	2.4													
			Flush Valve Water Closets	2.4.2	G												
			WaterSense Label for Flush	2.4.2	G												
			Valve Water Closet														
			Lavatories	2.4.1	G												
			WaterSense Label for Lavatory	2.4.1	S												
			Faucet														
			Kitchen Sinks	2.4.4	G												
			Service Sinks		G												
			Drinking-Water Coolers	2.4.8	G												
			Wheelchair Electric Water Cooler	2.4.9	G												
			Energy Star Label for Electric	2.4.8	S												
			Water Cooler														
			Energy Star Label for Wheelchair	2.4.9	S												
			Electric Water Cooler														
			WaterSense Label for	2.7.2	S												
			Showerhead														
			Water Heaters	2.10	G												
			Gas Instantaneous Water Heater	2.10.1	G												
			Pumps	2.11	G												
			Backflow Prevention Assemblies	3.9.1.1	G												
			Shower Faucets	2.7.2	G												
			Heat Trace	2.6	G												

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		22 00 00	Plumbing System	3.9.1													
			SD-06 Test Reports														
			Tests, Flushing and Disinfection	3.9													
			Test of Backflow Prevention Assemblies	3.9.1.1	G												
			SD-07 Certificates														
			Materials and Equipment	1.3													
			Bolts	2.1.1													
			SD-10 Operation and Maintenance Data														
			Plumbing System	3.9.1	G												
		23 05 93	SD-02 Shop Drawings														
			TAB Schematic Drawings and Report Forms	1.3.3	G												
			SD-03 Product Data														
			Equipment and Performance Data	1.3	G												
			TAB Related HVAC Submittals	1.5.1.3	G												
			SD-06 Test Reports														
			Completed Pre-Final DALT Report	3.3.5	G												
			Final DALT Report	3.3.8	G												
			SD-07 Certificates														
			Independent TAB Agency and Personnel Qualifications	1.5.1	G												

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		23 05 93	TAB Pre-Field Engineering Report	1.5.3	G												
		23 07 00	SD-02 Shop Drawings														
			MICA Plates	3.2.2.4	G												
			Pipe Insulation Systems	2.3													
			Pipe Insulation Systems	3.2													
			Duct Insulation Systems	3.3													
			Equipment Insulation Systems	3.4													
			Recycled content for insulation materials	2.3.1	S												
			SD-03 Product Data														
			Pipe Insulation Systems	2.3	G												
			Pipe Insulation Systems	3.2	G												
			Duct Insulation Systems	3.3	G												
			Equipment Insulation Systems	3.4	G												
			SD-04 Samples														
			Thermal Insulation	2.2.1.2	G												
			Display Samples	3.1.1	G												
			SD-07 Certificates														
			Indoor air quality for adhesives	2.2.1	S												
			SD-08 Manufacturer's Instructions														
			Pipe Insulation Systems	2.3	G												
			Pipe Insulation Systems	3.2	G												
			Duct Insulation Systems	3.3	G												
			Equipment Insulation Systems	3.4	G												
		23 09 00	SD-02 Shop Drawings														

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		23 09 00	DDC Contractor Design Drawings	3.2	G												
			Draft As-Built Drawings	3.2	G												
			Final As-Built Drawings	3.2	G												
			SD-03 Product Data														
			Programming Software	1.8.3	G												
			Controller Application Programs	1.8.4	G												
			Configuration Software	1.8.1	G												
			Controller Configuration Settings	1.8.2	G												
			Proprietary Multi-Split	1.1.1.3	G												
			Engineering Tool Software														
			Manufacturer's Product Data	2.2	G												
			SD-05 Design Data														
			Boiler Or Chiller Plant Gateway	1.9													
			Request														
			SD-06 Test Reports														
			Start-Up Testing Report	3.4.2	G												
			PVT Procedures	3.5.1	G												
			PVT Report	3.5.3	G												
			Pre-Construction Quality Control	1.10.1	G												
			(QC) Checklist														
			Post-Construction Quality Control	1.10.2	G												
			(QC) Checklist														
			SD-10 Operation and Maintenance														
			Data														
			Operation and Maintenance	3.6	G												
			(O&M) Instructions														

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		23 09 00	Training Documentation	3.8.1	G												
			SD-11 Closeout Submittals														
			Enclosure Keys	2.5	G												
			Password Summary Report	3.1.6.1	G												
			Closeout Quality Control (QC)	1.10.3	G												
			Checklist														
		23 11 20	SD-02 Shop Drawings														
			Gas Piping System	1.5.2	G												
			Gas Piping System	2.2	G												
			Gas Piping System	3.3	G												
			SD-03 Product Data														
			Gas Equipment Connectors	1.5.2	G												
			Gas Piping System and Pipe		G												
			Fittings														
			Valves	2.3	G												
			Warning and Identification Tape	2.2.5	G												
			Pipe coating materials	2.1	G												
			SD-06 Test Reports														
			Testing	3.17	G												
			Pressure Tests	3.17.1	G												
			Test with Gas	3.17.2	G												
			SD-07 Certificates														
			Welders Procedures and	1.5.1	G												
			Qualifications														
			Assigned Number, Letter, or	1.5.1	G												
			Symbol														

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		23 11 20	SD-10 Operation and Maintenance Data														
			Gas Facility System and Equipment Operation	1.3.1	G												
			Gas Facility System Maintenance	1.3.2	G												
			Gas Facility Equipment Maintenance	1.3.3	G												
		23 21 13.00 20	SD-02 Shop Drawings														
			Hot water heating system	1.3.1	G												
			SD-03 Product Data														
			Pumps	2.3.2	G												
			Expansion tanks	2.3.3													
			Flow control balancing valves	2.1.6.6													
			External air separation tanks	2.3.4													
			Hot water heating pipe	2.1.1	G												
			SD-06 Test Reports														
			Hydrostatic test of piping system	3.3.1													
			Auxiliary equipment and accessory tests	3.3.2													
			SD-07 Certificates														
			Report of prior installations	1.5.2.1													
			Welding procedures	1.5.2.2													
			Welder's qualifications	1.5.2.3													
		23 25 00	SD-03 Product Data														
			Chemical Feeder	2.3.1.1	G												
			Water Analysis	2.1.3	G												

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		23 25 00	Spare Parts	1.3													
			Field Instructions	3.4.1													
			Tests	3.3.1	G												
			Training Course	3.4.1	G												
		23 30 00	SD-02 Shop Drawings														
			Detail Drawings	1.4.4	G												
			SD-03 Product Data														
			Insulated Nonmetallic Flexible Duct Runouts	2.8.1.1													
			Duct Connectors	2.8.1.1													
			Duct Access Doors	2.8.2	G												
			Fire Dampers	2.8.3	G												
			Manual Balancing Dampers	2.8.6	G												
			Manual Balancing Dampers	2.8.7	G												
			Automatic Smoke-Fire Dampers	2.8.4	G												
			Automatic Smoke Dampers	2.8.5	G												
			Diffusers	2.8.10.1													
			Registers and Grilles	2.8.10.3													
			Louvers	2.8.12													
			Air Vents, Penthouses, and Goosenecks	2.8.13													
			Centrifugal Fans	2.9.1.1													
			In-Line Centrifugal Fans	2.9.1.2													
			High Volume, Low Speed Fans (HVLS)	2.9.1.5	G												

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		23 30 00	Variable Volume, Single Duct Terminal Units	2.11.1.1	G												
			Diagrams	1.2.1.2	G												
			Indoor Air Quality for Duct Sealants	2.8.1	S												
			Low Leakage Barometric Relief Damper	2.8.8	G												
			Linear Diffusers	2.8.10.2	G												
			Boiler Flue Vent	2.8.11	G												
			Upblast Centrifugal Fan	2.9.1.3	G												
			SD-06 Test Reports														
			Performance Tests	3.11	G												
			Damper Acceptance Test	3.9	G												
			SD-07 Certificates														
			Ozone Depleting Substances Technician Certification	1.4.3													
			SD-08 Manufacturer's Instructions														
			Manufacturer's Installation Instructions	3.2													
			Operation and Maintenance Training	3.13.2													
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance Manuals	3.13.1	G												
			Fire Dampers	2.8.3	G												

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		23 30 00	Manual Balancing Dampers	2.8.6	G												
			Manual Balancing Dampers	2.8.7	G												
			Automatic Smoke-Fire Dampers	2.8.4	G												
			Rooftop Air Handling Units		G												
			Variable Volume, Single Duct	2.11.1.1	G												
			Terminal Units														
			High Volume, Low Speed Fans (HVLS)	2.9.1.5	G												
			SD-11 Closeout Submittals														
			Indoor Air Quality During Construction	3.12	S												
		23 52 43.00 20	SD-02 Shop Drawings														
			Fuel Train	1.3.2.2													
			Wiring Diagram	1.3.2.2													
			SD-03 Product Data														
			Boilers	2.2													
			Boiler Trim and Control Equipment	2.4	G												
			Burners and Control Equipment	2.3	G												
			Energy Efficient Equipment For Boilers	2.1.1	S												
			Feedwater Treatment Feeder	2.4.9	G												
			SD-06 Test Reports														
			Operational Tests	3.5.1	G												
			Water Analysis	1.3.3													
			SD-07 Certificates														

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		23 52 43.00 20	Boilers	2.2	G												
			Burners and Control Equipment	2.3													
			Boiler Trim and Control Equipment	2.4													
			SD-08 Manufacturer's Instructions														
			Boilers	2.2													
			SD-10 Operation and Maintenance Data														
			Boilers	2.2													
			SD-11 Closeout Submittals														
			Boilers	2.2													
		23 81 00	SD-03 Product Data														
			Mini-Split-System Heat Pumps	2.3.2	G												
			Coil Corrosion Protection	2.6.1													
			Manufacturer's Standard Catalog Data	2.2													
			Self-Contained Air Conditioner	2.3.1	G												
			SD-06 Test Reports														
			Refrigerant Tests, Charging, and Start-Up	3.6	G												
			SD-07 Certificates														
			Service Organizations	3.7.2													
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance Manuals	3.7.1	G												

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		23 81 00	SD-11 Closeout Submittals														
			Ozone Depleting Substances	2.2.2.3	S												
		23 81 29	SD-01 Preconstruction Submittals														
			Qualification Of Installer	1.5.1.1	G												
			SD-02 Shop Drawings														
			VRF System Contractor Design	1.4.1	G												
			Drawings														
			SD-03 Product Data														
			Spare Parts Data	3.5.1	G												
			Coil Corrosion Protection	2.7.1	G												
			Manufacturer's Standard Catalog	2.1	G												
			Data														
			Sample Warranty	1.8	G												
			Refrigerant SDS Sheets	2.1.1.3	G												
			SD-05 Design Data														
			Manufacturer's Engineering Data	1.5.3	G												
			SD-06 Test Reports														
			System Performance Tests	3.3	G												
			SD-07 Certificates														
			Service Organizations	3.5.2	G												
			Warranty	3.5.3	G												
			Ozone Depleting Substances	1.5.1.2	G												
			Technician Certification														
			SD-08 Manufacturer's Instructions														
			Manufacturer's Instructions	1.5.4	G												

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		23 81 29	SD-09 Manufacturer's Field Reports														
			Refrigerant Charging	3.2.4	G												
			SD-11 Closeout Submittals														
			Posted Instructions	3.5.5	G												
			Inventory	1.7	G												
		23 82 00.00 20	SD-03 Product Data														
			Hydronic Cabinet Unit Heaters And Unit Heaters	2.1	G												
			Hydronic Radiator	2.3	G												
			Gas-Fired Unit Heater	2.2	G												
			Electric Baseboard Units	2.4	G												
			SD-10 Operation and Maintenance Data														
			Hydronic Cabinet Unit Heaters And Unit Heaters	2.1													
			Hydronic Radiator	2.3	G												
			Gas-Fired Unit Heater	2.2	G												
			Electric Baseboard Units	2.4	G												
		25 05 11.01	SD-01 Preconstruction Submittals														
			Wireless Communication Request	3.1.5.3	G												
			Device Account Lock Exception Request	3.1.2.2	G												
			Multiple IP Connection Device Request	1.5.1	G												

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		25 05 11.01	Contractor Computer Cybersecurity Compliance Statements	1.9.1.4	G												
			Contractor Temporary Network Cybersecurity Compliance Statements	1.9.6	G												
			SD-02 Shop Drawings														
			User Interface Banner Schedule	3.1.3.1	G												
			Network Communication Report	1.7.1	G												
			Cybersecurity Riser Diagram	1.7.4	G												
			Control System Inventory Report	1.7.2	G												
			SD-03 Product Data														
			Control System Cybersecurity Documentation	1.7.5	G												
			SD-06 Test Reports														
			Wireless Communication Test Report	3.1.5.4	G												
			SD-07 Certificates														
			Software Licenses	1.8	G												
			SD-11 Closeout Submittals														
			Password Summary Report	3.5.2.2.5	G												
			Software Recovery And Reconstitution Images	1.7.3	G												
			Device Audit Record Upload Software	3.2.2.1	G												
		25 05 11.02	SD-01 Preconstruction Submittals														

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		25 05 11.02	Wireless Communication	3.1.5.3	G												
			Request														
			Device Account Lock Exception	3.1.2.2	G												
			Request														
			Multiple IP Connection Device	1.5.1	G												
			Request														
			Contractor Computer	1.9.1.4	G												
			Cybersecurity Compliance														
			Statements														
			Contractor Temporary Network	1.9.6	G												
			Cybersecurity Compliance														
			Statements														
			SD-02 Shop Drawings														
			User Interface Banner Schedule	3.1.3.1	G												
			Network Communication Report	1.7.1	G												
			Cybersecurity Riser Diagram	1.7.4	G												
			Control System Inventory Report	1.7.2	G												
			SD-03 Product Data														
			Control System Cybersecurity	1.7.5	G												
			Documentation														
			SD-06 Test Reports														
			Wireless Communication Test	3.1.5.4	G												
			Report														
			SD-07 Certificates														
			Software Licenses	1.8	G												
			SD-11 Closeout Submittals														

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		25 05 11.02	Password Summary Report	3.5.2.2.5	G												
			Software Recovery And	1.7.3	G												
			Reconstitution Images														
			Device Audit Record Upload	3.2.2.1	G												
			Software														
		25 05 11.03	SD-01 Preconstruction Submittals														
			Wireless Communication	3.1.5.3	G												
			Request														
			Device Account Lock Exception	3.1.2.2	G												
			Request														
			Multiple IP Connection Device	1.5.1	G												
			Request														
			Contractor Computer	1.9.1.4	G												
			Cybersecurity Compliance														
			Statements														
			Contractor Temporary Network	1.9.6	G												
			Cybersecurity Compliance														
			Statements														
			SD-02 Shop Drawings														
			User Interface Banner Schedule	3.1.3.1	G												
			Network Communication Report	1.7.1	G												
			Cybersecurity Riser Diagram	1.7.4	G												
			Control System Inventory Report	1.7.2	G												
			SD-03 Product Data														
			Control System Cybersecurity	1.7.5	G												
			Documentation														

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		25 05 11.03	SD-06 Test Reports														
			Wireless Communication Test Report	3.1.5.4	G												
			SD-07 Certificates														
			Software Licenses	1.8	G												
			SD-11 Closeout Submittals														
			Password Summary Report	3.5.2.2.5	G												
			Software Recovery And Reconstitution Images	1.7.3	G												
			Device Audit Record Upload	3.2.2.1	G												
			Software														
		26 05 33	SD-02 Shop Drawings														
			600 V Power Connection Station	2.1	G												
			Ship Service Emergency Trip Panel	2.3	G												
			SD-03 Product Data														
			600 V Single Pole Connectors	2.1.2	G												
			Industrial Service Auxiliary Devices	2.1.4	G												
			Metering Accessories	2.1.5	G												
			SD-06 Test Reports														
			Paint Coating System	2.7.1	G												
			600 V Single Pole Connector Compatibility Tests	2.7.2	G												
			600 V Single Pole Connector	2.7.3	G												
			Torque Test														

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 05 33	Acceptance Checks and Tests	3.6.1	G												
			SD-10 Operation and Maintenance Data														
			600 V Power Connection Station	2.1	G												
			Ship Service Emergency Trip Panel	2.3	G												
		26 05 48.00 10	SD-02 Shop Drawings														
			Lighting Fixtures and Poles														
			Equipment Requirements	1.3													
			SD-03 Product Data														
			Lighting Fixtures and Poles		G												
			Equipment Requirements	1.3	G												
			Contractor Designed Bracing	1.2.4	G												
		26 08 00	SD-06 Test Reports														
			Acceptance tests and inspections	3.1	G												
			SD-07 Certificates														
			Qualifications	1.4.1	G												
			Acceptance test and inspections procedure	1.4.3	G												
		26 11 16	SD-02 Shop Drawings														
			Unit Substation Drawings	1.5.1.1	G												
			Transformer drawings	1.5.1.2	G												
			SD-03 Product Data														
			Fuse curves	1.5.1.1	G												
			Secondary unit substation	2.2	G												
			transformer (liquid-filled)	2.2.2	G												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 11 16	SD-06 Test Reports														
			Acceptance checks and tests	3.5.1	G												
			SD-07 Certificates														
			Paint coating system	1.5.2	G												
			Transformer Losses	1.5.3	G												
			SD-09 Manufacturer's Field														
			Reports														
			Load Interrupter Switch	2.6.2	G												
			production tests														
			transformer design tests	2.6.3	G												
			(liquid-filled)														
			transformer routine and other	2.6.4	G												
			tests (liquid-filled)														
			SD-10 Operation and Maintenance														
			Data														
			Unit substations	2.2	G												
			SD-11 Closeout Submittals														
			Assembled Operation and	1.6.1	G												
			Maintenance Manuals														
			Equipment test schedule	2.6.1	G												
		26 12 19.10	SD-02 Shop Drawings														
			Pad-mounted Transformer	1.5.1	G												
			Drawings														
			SD-03 Product Data														
			Pad-mounted Transformers	2.2	G												
			SD-06 Test Reports														

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
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		26 12 19.10	Acceptance Checks and Tests	3.6.1	G												
			SD-07 Certificates														
			Transformer Efficiencies	2.2.2.1	G												
			SD-09 Manufacturer's Field Reports														
			Transformer Test Schedule	2.7.1	G												
			Design Tests	2.7.2	G												
			Routine and Other Tests	2.7.3	G												
			SD-10 Operation and Maintenance Data														
			Transformer(s)	1.6.1	G												
		26 13 00	SD-02 Shop Drawings														
			Switchgear Drawings	1.5.1	G												
			SD-03 Product Data														
			Electronic Overcurrent Control Curves	1.5.3	G												
			SF6/High-Firepoint Fluid	1.6.1	G												
			Insulated Pad-mounted Switchgear														
			SF6/High-Firepoint Fluid	2.1	G												
			Insulated Pad-mounted Switchgear														
			Insulated High-Voltage Connectors	2.2	G												
			Surge Arresters	2.3	G												
			SD-06 Test Reports														
			Acceptance Checks and Tests	3.4.1	G												
			SD-07 Certificates														

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 13 00	Paint Coating System	1.5.2	G												
			Cybersecurity	1.7	G												
			SD-09 Manufacturer's Field Reports														
			Switchgear design and production tests	2.5.1	G												
			SD-10 Operation and Maintenance Data														
			SF6/High-Firepoint Fluid	1.6.1	G												
			Insulated Pad-mounted Switchgear														
			SF6/High-Firepoint Fluid	2.1	G												
			Insulated Pad-mounted Switchgear														
		26 13 01	SD-02 Shop Drawings														
			Switchgear Drawings	1.5.1	G												
			SD-03 Product Data														
			Fuse Time-Current Characteristic Curves	1.5.3	G												
			Air Insulated Pad-mounted Switchgear	2.1	G												
			Insulated High-Voltage Connectors	2.2	G												
			Surge Arresters	2.3	G												
			SD-06 Test Reports														
			Acceptance Checks and Tests	3.4.1	G												
			SD-07 Certificates														
			Paint Coating System	1.5.2	G												

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 13 01	SD-09 Manufacturer's Field Reports														
			Switchgear Design and Production Tests	2.6.1	G												
			SD-10 Operation and Maintenance Data														
			Air Insulated Pad-Mounted Switchgear Operation and Maintenance	1.6.1	G												
		26 20 00	SD-02 Shop Drawings														
			Panelboards	2.12	G												
			Transformers	2.16	G												
			Cable Trays	2.3	G												
			Marking Strips	3.1.9.1	G												
			SD-03 Product Data														
			Receptacles	2.11	G												
			Circuit Breakers	2.12.3	G												
			Switches	2.9	G												
			Transformers	2.16	G												
			Enclosed Circuit Breakers	2.14	G												
			Motor Controllers	2.18	G												
			Manual Motor Starters	2.19	G												
			CATV Outlets	2.22.1	G												
			Grounding Busbar	2.23.3	G												
			Surge Protective Devices	2.29	G												
			SD-06 Test Reports														

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 20 00	600-volt Wiring Test	3.5.2	G												
			Grounding System Test	3.5.5	G												
			Transformer Tests	3.5.3	G												
			Ground-fault Receptacle Test	3.5.4	G												
			SD-07 Certificates														
			Fuses	2.10	G												
			SD-09 Manufacturer's Field Reports														
			Transformer Factory Tests	2.31.1													
			SD-10 Operation and Maintenance Data														
			Electrical Systems	1.5.1	G												
		26 23 00	SD-02 Shop Drawings														
			Switchgear Drawings	1.5.2	G												
			SD-03 Product Data														
			Switchgear	2.2	G												
			SD-06 Test Reports														
			Switchgear Design Tests	2.5.2	G												
			Switchgear Production Tests	2.5.3	G												
			Acceptance Checks and Tests	3.5.1	G												
			SD-07 Certificates														
			Cybersecurity Equipment Certification	2.5.4	G												
			Cybersecurity Installation Certification	3.5.1.6	G												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 23 00	SD-10 Operation and Maintenance Data														
			Switchgear Operation and Maintenance	1.6.1	G												
			SD-11 Closeout Submittals Assembled Operation and Maintenance Manuals	1.6.2	G												
			Equipment Test Schedule Required Settings	2.5.1 3.5	G G												
		26 24 13	SD-02 Shop Drawings														
			Switchboard Drawings	1.5.2	G												
			SD-03 Product Data														
			Switchboard	2.2	G												
			SD-06 Test Reports														
			Switchboard Design Tests	2.5.2	G												
			Switchboard Production Tests	2.5.3	G												
			Acceptance Checks and Tests	3.5.1	G												
			SD-10 Operation and Maintenance Data														
			Switchboard Operation and Maintenance	1.6.1	G												
			SD-11 Closeout Submittals Assembled Operation and Maintenance Manuals	1.6.2	G												
			Equipment Test Schedule	2.5.1	G												
			Required Settings	3.5	G												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 24 13	Service Entrance Available Fault Current Label	2.7	G												
		26 27 14.00 20	SD-02 Shop Drawings														
			Installation Drawings	1.3.1	G												
			SD-03 Product Data														
			Electricity Meters	2.1.4	G												
			Current Transformer	2.1.3	G												
			Potential Transformer	2.1.2	G												
			Communications	2.2	G												
			Configuration Software	3.1.2	G												
			SD-06 Test Reports														
			Acceptance Checks and Tests	3.2.1	G												
			System Functional Verification	3.2.2	G												
			Building Meter Installation Sheet, per Building	3.2.1	G												
			Completed Meter Installation Schedule	3.2.1	G												
			Completed Meter Data Schedule	3.2.1	G												
			Meter Configuration Template	2.1.1	G												
			Meter Configuration Report	3.2.1	G												
			SD-10 Operation and Maintenance Data														
			Electricity Meters and Accessories	1.4.1	G												
			SD-11 Closeout Submittals														
			System Functional Verification	3.2.2	G												

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		26 29 23	SD-02 Shop Drawings														
			Schematic Diagrams	1.5.1	G												
			Interconnecting Diagrams	1.5.2	G												
			Installation Drawings	1.5.3	G												
			As-Built Drawings	1.5.3	G												
			SD-03 Product Data														
			Adjustable Speed Drives	2.1	G												
			Wires and Cables	2.3													
			Equipment Schedule	1.5.4													
			SD-06 Test Reports														
			ASD Test	3.3.1													
			Performance Verification Tests	3.3.2													
			Endurance Test	3.3.3													
			SD-07 Certificates														
			Testing Agency's Field Supervisor	3.3.1	G												
			SD-08 Manufacturer's Instructions														
			Installation instructions	1.5.5													
			SD-09 Manufacturer's Field Reports														
			ASD Test Plan	2.5.1	G												
			Standard Products	1.5.6													
			SD-10 Operation and Maintenance Data														
			Adjustable Speed Drives	2.1													
		26 32 15.00	SD-02 Shop Drawings														

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		26 32 15.00	Engine-Generator Set and Auxiliary Equipment	2.1.1	G												
			Auxiliary Systems	1.4.10	G												
			Detailed Drawings	1.4.9	G												
			Acceptance	3.14	G												
			SD-03 Product Data														
			Harmonic Requirements	2.1.8	G												
			Engine-Generator Set	2.1.1	G												
			Efficiencies														
			Emissions	2.12	G												
			Filters	2.7.2	G												
			Special tools	2.14	G												
			Remote Alarm Annunciator	2.13.4	G												
			Engine-Generator Parameter	2.1.1													
			Schedule														
			Heat Exchanger	2.8.1													
			Generator	2.15													
			Manufacturer's Catalog	2.5													
			Site Welding	1.4.2													
			Spare Parts	1.7.2													
			Instructions	3.5.7.1	G												
			Experience	1.4.7													
			Field Engineer	1.4.8													
			General Installation	3.2													
			Exciter	2.16													
			SD-05 Design Data														

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		26 32 15.00	Performance Criteria	2.15													
			Sound Limitations	2.9	G												
			Power Factor	3.5.1.2													
			Time-Delay on Alarms	2.19.5													
			Cooling System	2.8													
			Vibration Isolation	2.1.7													
			Battery Charger	2.13.3.2													
			Capacity Calculations for Engine-Generator Set	2.1.1	G												
			Torsional Vibration Stress Analysis Computations	2.1.1	G												
			Capacity Calculations for Batteries	2.1.1	G												
			Turbocharger Load Calculations	2.1.1	G												
			SD-06 Test Reports														
			Performance Tests	3.5.9													
			Factory Inspection and Tests	2.28													
			Factory Tests	2.28.2													
			Onsite Inspection and Tests	3.5	G												
			Acceptance Checks and Tests	3.8.1	G												
			Functional Acceptance Tests	3.9.2	G												
			Maintenance Procedures	3.10.2.2	G												
			Operation and Maintenance Manuals	1.7.3	G												
			Inspections	3.5.3	G												

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		26 32 15.00	Functional Acceptance Test Procedure	3.8.5	G												
			SD-07 Certificates														
			Cooling System	2.8													
			Vibration Isolation	2.1.7													
			Reliability and Durability	2.1.5													
			Start-Up Engineer	3.7	G												
			Instructor's Qualification Resume	3.10.1	G												
			Sound Limitations	2.9													
			Site Visit	3.1													
			Current Balance	2.15.1													
			Materials and Equipment	2.4													
			Factory Inspection and Tests	2.28													
			Engine Tests	3.5.4	G												
			Generator Tests	3.5.5	G												
			Assembled Engine-Generator Set Tests	3.5.6	G												
			SD-10 Operation and Maintenance Data														
			Preliminary Assembled Operation and Maintenance Manuals	3.8.4	G												
			Training Plan	3.10.2	G												
		26 33 53	SD-02 Shop Drawings														
			UPS Drawings	1.5.1	G												
			UPS Installation	1.5.2	G												
			SD-03 Product Data														

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		26 33 53	UPS Module	2.2.1	G												
			Technical Requirements UPS System	2.4													
			SD-06 Test Reports														
			Work Plan	1.5.3													
			Factory Test Plan	1.5.4													
			Factory Test Report	1.5.5	G												
			SD-09 Manufacturer's Field Reports														
			Initial Inspection and Tests	3.2.2	G												
			Performance Tests	3.2.3	G												
			Performance Test Plan	1.5.6													
			Performance Test Report	1.5.7													
			SD-10 Operation and Maintenance Data														
			UPS Operation and Maintenance	1.4.1	G												
			SD-11 Closeout Submittals														
			Installation	3.1													
		26 36 23	SD-02 Shop Drawings														
			Automatic Transfer Switch Drawings	1.5.2	G												
			SD-03 Product Data														
			Automatic Transfer Switches	2.1	G												
			SD-06 Test Reports														
			Acceptance Checks and Tests	3.3.1													
			Functional Acceptance Tests	3.3.2													

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		26 36 23	Factory Testing	2.3													
			Factory Test Reports	2.3.2													
			SD-07 Certificates														
			Proof of Listing	1.5.1													
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance Manual	1.4	G												
		26 41 00	SD-02 Shop Drawings														
			Overall lightning protection system	1.4.1.1	G												
			Each major component	1.4.1.2	G												
			SD-06 Test Reports														
			Lightning Protection and Grounding System Test Plan	1.4.3	G												
			Lightning Protection and Grounding System Test	3.4.1	G												
			SD-07 Certificates														
			Lightning Protection System Installers Documentation	1.2.3	G												
			Component UL Listed and Labeled	1.4.2	G												
			Lightning protection system inspection certificate	1.4.4	G												
			Roof manufacturer's warranty	3.1.1	G												
		26 42 13	SD-02 Shop Drawings														

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		26 42 13	Anode junction boxes, bonding boxes, and test stations	2.2.2													
			SD-03 Product Data														
			Qualifications	1.4.2													
			Anode junction boxes, bonding boxes, and test stations	2.2.2													
			Permanent reference electrodes	2.3.5	G												
			Cable And Wire	2.3.3	G												
			SD-06 Test Reports														
			Tests and Measurements	3.4.1	G												
			SD-10 Operation and Maintenance Data														
			Cathodic Protection System	3.4	G												
			Cathodic Protection System	3.4	G												
			SD-11 Closeout Submittals														
			Initial Cathodic Protection System	3.4.1.4	G												
			Field Testing														
			Final Cathodic Protection System	3.4.1.6	G												
			Field Test Report														
		26 51 00	SD-02 Shop Drawings														
			Luminaire Drawings	1.5.1	G												
			Occupancy/Vacancy Sensor	1.5.7	G												
			Coverage Layout														
			Lighting Control System One-Line Diagram	1.7.2	G												

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		26 51 00	Sequence of Operation for Lighting Control System	2.5.1	G												
			SD-03 Product Data														
			Luminaires	2.2	G												
			Light Sources	2.3	G												
			LED Drivers	2.4	G												
			Luminaire Warranty	1.6.1	G												
			Lighting Controls Warranty	1.6.2	G												
			Local Area Controller	2.5.1.1.1	G												
			Lighting Control Panel	2.5.1.2.1	G												
			Switches	2.5.2.1	G												
			Wall Box Dimmers	2.5.2.2	G												
			Occupancy/Vacancy Sensors	2.5.2.3	G												
			Photosensors	2.5.2.4	G												
			Power Packs	2.5.2.3.3	G												
			Power Hook Luminaire Hangers	2.7.4	G												
			Exit Signs	2.6.1	G												
			Emergency Drivers	2.6.3	G												
			SD-06 Test Reports														
			IES LM-79 Test Report	1.5.2													
			IES LM-80 Test Report	1.5.3													
			IES TM-21 Test Report	1.5.4													
			IES TM-30 Test Report	1.5.5													
			Occupancy/Vacancy Sensor	3.2.1.1													
			Verification Test														
			Photosensor Verification Test	3.2.1.1													

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		26 51 00	SD-07 Certificates														
			LED Driver and Dimming Switch	1.5.6													
			Compatibility Certificate														
			SD-10 Operation and Maintenance														
			Data														
			Lighting System	1.7.1													
			Lighting Control System	1.7.2													
			Maintenance Staff Training Plan	3.3.2.1													
			End-User Training Plan	3.3.2.2													
		26 56 00	SD-02 Shop Drawings														
			High Mast Tower Drawings	1.5.6	G												
			Fixed Head Assembly	2.6.3	G												
			Luminaire Ring	2.6.4	G												
			Luminaire Drawings	1.5.1.1	G												
			Pole Drawings	1.5.1.2	G												
			Control System One-Line	1.8.2	G												
			Diagram														
			Sequence of Operation for	2.5.1	G												
			Exterior Lighting Control System														
			SD-03 Product Data														
			High Mast Tower	1.6.1	G												
			High Mast Tower	2.6.1	G												
			Fixed Head Assembly	2.6.3	G												
			Luminaire Ring	2.6.4	G												
			Lowering Device	2.6.2	G												
			Drive Motor Set	2.6.7	G												

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		26 56 00	Obstruction Lighting	2.6.8	G												
			Luminaires	2.2	G												
			Light Sources	2.3	G												
			LED Drivers	2.4	G												
			Luminaire Warranty	1.7.1	G												
			Lighting Controls Warranty	1.7.2	G												
			Pole Warranty	1.7.3	G												
			Photosensors	2.5.2.1	G												
			Poles	2.7	G												
			Brackets	2.7.2													
			SD-05 Design Data														
			High Mast Tower Design Data	1.5.6	G												
			Luminaire Design Data	1.5.2	G												
			SD-06 Test Reports														
			IES LM-79 Test Report	1.5.3													
			IES LM-80 Test Report	1.5.4													
			IES TM-21 Test Report	1.5.5													
			SD-08 Manufacturer's Instructions														
			Poles	2.7													
			SD-10 Operation and Maintenance Data														
			Lighting System	1.8.1	G												
			Exterior Lighting Control System	1.8.2	G												
			Maintenance Staff Training Plan	3.3.1.1	G												
			End-User Training Plan	3.3.1.2	G												
		27 05 13.43	SD-02 Shop Drawings														

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		27 05 13.43	Wiring Diagrams And Installation Details	1.5.1	G												
			System Components		G												
			SD-03 Product Data														
			Cables	2.1.1	G												
			Terminators	2.1.2	G												
			Splitters/Combiners		G												
			Line Taps	2.1.3	G												
			Coaxial Outlets	2.1.4	G												
			Coaxial Connectors	2.1.5	G												
			SD-05 Design Data														
			Television Distribution System		G												
			Loss Calculations														
			SD-06 Test Reports														
			Operational Test Plan	1.5.2	G												
			Operational Test Procedures	1.5.3	G												
			System Pretest	3.2.1	G												
			Acceptance Tests	3.2.2	G												
			SD-08 Manufacturer's Instructions														
			Connector Installation	1.5.4	G												
			SD-10 Operation and Maintenance														
			Data														
			Operation and Maintenance	3.3	G												
			Manuals														
		27 10 00	SD-02 Shop Drawings														
			Telecommunications drawings	1.6.1.1	G												

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		27 10 00	Telecommunications Space Drawings	1.6.1.2	G												
			SD-03 Product Data														
			Telecommunications cabling	2.3	G												
			Patch panels	2.4.5	G												
			Telecommunications outlet/connector assemblies	2.5	G												
			Equipment support frame	2.4.2	G												
			Connector blocks	2.4.3	G												
			SD-06 Test Reports														
			Telecommunications cabling testing	3.5.1	G												
			SD-07 Certificates														
			Telecommunications Contractor	1.6.2.1	G												
			Key Personnel	1.6.2.2	G												
			Manufacturer Qualifications	1.6.2.3	G												
			Test plan	1.6.3	G												
			SD-09 Manufacturer's Field Reports														
			Factory reel tests	2.10.1													
			SD-10 Operation and Maintenance Data														
			Telecommunications cabling and pathway system	1.10.1	G												
			SD-11 Closeout Submittals														
			Record Documentation	1.10.2	G												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		27 32 50.00 22	SD-02 Shop Drawings														
			Nameplates	1.5.1.1.1	G												
			Wiring Diagrams	1.5.1.1.1	G												
			System Layout	1.5.1.1.1	G												
			Identifying And Instructional Signage	1.5.1.1.1	G												
			SD-03 Product Data														
			Technical Data And Computer Software	1.5.1.1.2	G												
			Base / Master Station	2.4.1	G												
			Power Supply	2.4.3	G												
			Call Boxes	2.4.2	G												
			Cabling And Wiring	2.4.4	G												
			SD-06 Test Reports														
			Field Quality Control	1.5.1.2.1	G												
			Testing Procedures	1.5.1.2.2	G												
			SD-07 Certificates														
			Installer	1.5.1.3.1	G												
			Qualified Professional Engineer (Qpe)	1.5.1.3.2	G												
			Request For Inspection And Tests	1.5.1.3.3	G												
			Testing	1.5.1.3.4	G												
			Instructor	3.5.1	G												
			SD-10 Operation and Maintenance Data														

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		27 32 50.00 22	Operation And Maintenance (O&M) Instructions	1.5.1.4.1	G												
			SD-11 Closeout Submittals														
			As-Built Drawings	1.5.1.4.2	G												
		28 08 10	SD-05 Design Data														
			Test Plan	3.1	G												
			SD-06 Test Reports														
			Draft Test Report	3.2.2													
			Final Test Report	3.4	G												
			SD-07 Certificates														
			Qualifications	1.4.1													
		28 10 05	SD-02 Shop Drawings														
			ESS Components	1.3.3.1	G												
			Overall System Schematic	1.3.3.2	G												
			SD-03 Product Data														
			Premise Control Unit	2.4.6	G												
			Detection Sensors	2.4.7	G												
			Access Control Unit	2.5.4	G												
			Access Control Devices	2.5.5	G												
			Cameras	2.6.1	G												
			Video Recording	2.6.2.3	G												
			Communications Interface		G												
			Devices														
			Network Switch	2.9.3	G												
			Media Converter Chassis	2.6.4	G												
			Chassis Media Converter	2.6.5.2	G												

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		28 10 05	Camera Media Converter	2.6.5.1	G												
			Video and ESS Transmission	2.9.4	G												
			Batteries	2.10.1	G												
			Component Enclosure	2.12	G												
			SD-05 Design Data														
			Backup Battery Capacity	1.5.1	G												
			Calculations														
			Throughput Rates	2.5.2													
			CCTV Storage Calculations	1.5.2													
			SD-07 Certificates														
			Contractor Qualifications	1.3.4.1	G												
			Instructor Qualifications	1.3.4.2	G												
			SD-10 Operation and Maintenance														
			Data														
			Training Plan	3.6.1													
			Training Content	3.6													
			ESS Components	1.3.3.1	G												
			ESS Software	1.6	G												
			SD-11 Closeout Submittals														
			As-Built Drawings	1.7													
		28 31 76	SD-01 Preconstruction Submittals														
			Qualified Fire Protection Engineer	1.3.2	G												
			(QFPE)														
			Fire alarm system designer	1.9.2.1	G												
			Supervisor	1.9.2.2	G												
			Technician	1.9.2.3	G												

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		28 31 76	Installer	1.9.2.4	G												
			Test Technician	1.9.2.5	G												
			Fire Alarm System Site-Specific	1.7	G												
			Software Acknowledgement														
			SD-02 Shop Drawings														
			Nameplates	1.9.1.3	G												
			Instructions	2.2.4	G												
			Wiring Diagrams	1.9.1.4	G												
			System Layout	1.9.1.5	G												
			Notification Appliances	1.9.1.6	G												
			Initiating devices	1.9.1.7	G												
			Amplifiers	1.9.1.8	G												
			Battery Power	1.9.1.9	G												
			Voltage Drop Calculations	1.9.1.10	G												
			Radio Transmitter and Interface	2.20.1	G												
			Panels														
			SD-03 Product Data														
			Fire Alarm and Mass Notification	2.3	G												
			Control Unit (FACU/ACU)														
			Local Operating Console (LOC)	1.4.3	G												
			Amplifiers	1.9.1.8	G												
			LCD Annunciator	2.6.1	G												
			Manual Stations	2.7	G												
			Smoke Detectors	2.8	G												
			Duct Smoke Detectors	2.8.2	G												
			Air sampling smoke detectors	3.2.7	G												

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		28 31 76	Carbon monoxide detector	2.10	G												
			Addressable Interface Devices	2.11	G												
			Addressable Control Modules	2.12	G												
			Isolation Modules	2.13	G												
			Notification Appliances	1.9.1.6	G												
			Textual Display Sign Control	2.14.3	G												
			Panel														
			Textual Display Signs	2.14.3	G												
			Batteries	2.16.1	G												
			Battery Chargers	2.16.2	G												
			Supplemental Notification	2.16.1.1	G												
			Appliance Circuit Panels														
			Auxiliary Power Supply Panels	2.16.1.1	G												
			Surge Protective Devices	2.17	G												
			Alarm Wiring	2.17	G												
			Ceiling Bridges	3.2.10	G												
			Automatic Fire Alarm	2.20	G												
			Transmitters														
			Mass Notification Transceiver	2.19.1	G												
			Document Storage Cabinet	3.10.3	G												
			SD-05 Design Data														
			Air Sampling Smoke Detection	1.9.1.12	G												
			System Calculations														
			SD-06 Test Reports														
			Test Procedures	3.6.1	G												
			SD-07 Certificates														

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		28 31 76	Verification of Compliant Installation	3.6.2.1	G												
			Request for Government Final Test	3.6.2.2	G												
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance (O&M) Instructions	3.8	G												
			Instruction of Government Employees	3.9	G												
			SD-11 Closeout Submittals														
			As-Built Drawings	1.9.1.14	G												
			Spare Parts	1.11.1	G												
		31 11 00	SD-03 Product Data														
			Tree Wound Paint	2.1.1													
		31 21 13	SD-03 Product Data														
			Respirators	1.8.3.1	G												
			Vapor Mitigation Systems Components	2.1.2													
			SD-06 Test Reports														
			Post Mitigation Testing	3.3.2	G												
			SD-07 Certificates														
			Worker Protection Plan	1.7	G												
			Medical Certification	1.7.3	G												
			Worker Notification	1.7.4	G												
			Respiratory Protection Program	1.8	G												

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		31 21 13	Contractor Qualifications	1.9.1.1	G												
			Contractor Experience	1.9.1.2	G												
			Testing Laboratory Certification	1.9.2	G												
			Proof Of Current Calibration For Testing Devices	1.9.3	G												
			Vapor Mitigation System Inspection	3.3.1	G												
			SD-08 Manufacturer's Instructions Vapor Mitigation Systems Components	2.1.2													
			SD-10 Operation and Maintenance Data														
			Vapor Mitigation Systems	2.1	G												
			SD-11 Closeout Submittals Radon Detector Location Log Respirator Program Records	1.8.1	G												
		31 23 00.00 20	SD-01 Preconstruction Submittals														
			Shoring and Sheeting Plan	1.7.1													
			Dewatering work plan	1.7.2													
			SD-06 Test Reports Borrow Site Testing		G												
			Fill and backfill	3.14.2.1													
			Select material	3.14.2.2													
			Porous fill	3.14.2.3													
			Density tests	3.14.2.4													
		31 41 16	SD-01 Preconstruction Submittals														

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		31 41 16	Installation Procedures	3.3.1.1	G												
			SD-02 Shop Drawings														
			Metal Piling	2.1	G												
			Pile Splicing	3.3.2	G												
			Pile Placement	3.3.1.1	G												
			As-Driven Survey	3.3.5	G												
			Pile Shoe	3.3.1.3	G												
			Predrilling Or 'Core Beam'	3.3.1.2													
			SD-03 Product Data														
			Driving	3.3.1.3													
			Pile Driving Equipment	2.4	G												
			Delivery, Storage, and Handling	1.5	G												
			Pulling and Redriving	3.3.4	G												
			SD-05 Design Data														
			Procedure for Insufficient Pile Length	3.3.2	G												
			SD-06 Test Reports														
			Materials Tests	2.3.1													
			SD-07 Certificates														
			Pile Shoe	3.3.1.3	G												
			Steel Plant Certificate	2.3	G												
			SD-11 Closeout Submittals														
			Pile Driving Record	3.8	G												
		31 62 16.13	SD-01 Preconstruction Submittals														
			Installation Procedures	1.8.2	G												

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		31 62 16.13	Contractor's Geotechnical Consultant	1.3.1	G												
			Testing Agency Qualifications	3.3.3	G												
			Wave Equation Analysis	1.8.2	G												
			SD-02 Shop Drawings														
			Piles	1.8.1	G												
			Pile Splices	2.2.2	G												
			Pile Placement	3.2.3	G												
			As-Driven Survey	3.2.3.1	G												
			Pile Shoes	2.2.3	G												
			SD-03 Product Data														
			Pile Driving Equipment	1.8.2	G												
			SD-05 Design Data														
			Quantities List	3.1.2	G												
			SD-06 Test Reports														
			Test Piles	3.2.6	G												
			Test Piles	3.3.1	G												
			Dynamic Pile Analysis	3.3.1.1	G												
			SD-07 Certificates														
			Pile Shoes	2.2.3	G												
			Welder Certification	2.2.4.1	G												
			Steel Plant Certification	2.2.4	G												
			Mill Certificates	1.7.2													
			Fabricator's Certification	1.7.1													
			Welder Qualifications	2.2.4.1	G												
			SD-11 Closeout Submittals														

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		31 62 16.13	Pile Records	3.3.2	G												
		31 62 16.16	SD-01 Preconstruction Submittals														
			Installation Procedures	1.7.4	G												
			Contractor's Geotechnical Consultant	1.7.2	G												
			Testing Agency Qualification	3.3.3	G												
			Wave Equation Analysis	3.1.1	G												
			SD-02 Shop Drawings														
			Pile splices	2.2.5.1	G												
			Pile placement	3.2.3	G												
			Pile Points														
			SD-03 Product Data														
			Pile Driving Equipment	1.7.4	G												
			Pile Driving Records	3.2.2	G												
			Delivery, Storage, and Handling	1.6	G												
			SD-05 Design Data														
			Wave Equation Analysis	3.1.1													
			Quantities List	3.1.2	G												
			Procedure for Insufficient Pile Length	3.2.8.2	G												
			SD-06 Test Reports														
			Test Pile	2.1	G												
			Load Test	2.1	G												
			Dynamic Pile Analysis	3.3.1.1	G												
			Pile Performance Report	3.3.1.5													
			SD-07 Certificates														

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		31 62 16.16	Pile Material Certificates of Compliance	2.2.1	G												
			Pile Splices	2.2.5.1	G												
			Pile Shoes	2.2.5.2	G												
			SD-11 Closeout Submittals														
			Pile Driving Records	3.2.2													
		31 63 29	SD-01 Preconstruction Submittals														
			Drilled Shaft Contractor Qualifications	1.3.1													
			Installation Plan	1.3.2													
			SD-02 Shop Drawings														
			Steel Reinforcement	2.1.1	G												
			SD-05 Design Data														
			Mix Design Data	2.1	G												
			SD-06 Test Reports														
			Slump	3.4.1.1													
			Compressive Strength	3.4.2.1	G												
			Drilled Shaft Installation Logs	1.4.3	G												
			SD-07 Certificates														
			Bill of Lading for Ready-Mix Concrete Deliveries	2.1													
			Steel Reinforcement	2.1.1													
			Welding Certificates	1.3.4													
			Excavation and Drilling	2.2.1													
			Equipment														
		32 05 33	SD-01 Preconstruction Submittals														

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		32 05 33	Integrated Pest Management Plan	2.4	G												
			SD-03 Product Data														
			Fertilizer	2.1	G												
			Mulches Topdressing	2.3													
			Organic Mulch Materials	2.3.1													
			SD-07 Certificates														
			Maintenance Inspection Report	3.5.1													
			Plant Quantities	3.5.2	G												
			SD-10 Operation and Maintenance Data														
			Maintenance	1.6													
			SD-11 Closeout Submittals														
			Tree Staking Removal	3.5.3													
		32 11 23	SD-03 Product Data														
			Plant, Equipment, and Tools	1.4	G												
			SD-06 Test Reports														
			Initial Tests	2.3.1	G												
			In-Place Tests	3.13.1	G												
		32 12 16.16	SD-02 Shop Drawings														
			Placement Plan	2.1	G												
			SD-03 Product Data														
			Diamond Grinding Plan	2.1.6	G												
			Mix Design	2.4	G												
			Contractor Quality Control	3.1	G												
			SD-04 Samples														

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		32 12 16.16	Aggregates	2.2													
			SD-06 Test Reports														
			Aggregates	2.2	G												
			QC Monitoring	3.1.3.9													
			SD-07 Certificates														
			Asphalt Cement Binder	2.3	G												
			Laboratory Accreditation and Validation	1.3.11													
		32 17 23	SD-03 Product Data														
			Surface Preparation Equipment List	2.1.1.1	G												
			Application Equipment List	2.1.2	G												
			Exterior Surface Preparation	3.2													
			Safety Data Sheets	1.3.1	G												
			Waterborne Paint	2.2.1	G												
			Thermoplastic compound	2.2.2	G												
			Thermoplastic compound	3.3.2	G												
			SD-06 Test Reports														
			Reflective Media for Roads	2.2.3.1	G												
			Waterborne Paint	2.2.1	G												
			Thermoplastic Compound	2.2.2	G												
			Thermoplastic Compound	3.3.2	G												
			SD-07 Certificates														
			Qualifications	1.3.2	G												
			Reflective Media for Roads	2.2.3.1													
			Waterborne Paint	2.2.1													

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		32 17 23	Volatile Organic Compound	1.3.1	G												
			Thermoplastic Compound	2.2.2													
			Thermoplastic Compound	3.3.2													
			SD-08 Manufacturer's Instructions														
			Waterborne Paint	2.2.1	G												
			Thermoplastic Compound	2.2.2	G												
			Thermoplastic Compound	3.3.2	G												
		32 31 13.53	SD-02 Shop Drawings														
			Fence Installation Drawings	3.2.1	G												
			Vertical Pivot Gate Installation	3.2.1	G												
			Drawings														
			Automatic Sliding Gate	3.2.1	G												
			Installation Drawings														
			SD-03 Product Data														
			Fabric	2.1.1.1													
			Posts	2.1.2													
			Post Caps	2.1.2.2													
			Chain Link Braces	2.1.3													
			Line Posts	2.1.3													
			Sleeves	3.2.3.2													
			Top Rail	2.1.3													
			Bottom Rail	2.1.3													
			Tension Wire	2.1.2.2													
			Barbed Wire	2.2.1.2													
			Barbed Wire Supporting Arms	2.1.2.2													
			Barbed Tape	2.2.2													

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		32 31 13.53	Latches	2.1.4.3													
			Hinges	2.1.4.3													
			Stops	2.1.4.3													
			Keepers	2.1.4.3													
			Panic Bars and Trim	2.1.4.3													
			Closers	2.1.4.3													
			Rollers	2.1.4.3													
			Turnstiles	3.2.1													
			Padlocks	2.1.6													
			Wire Ties	2.2.1.1													
			Slide Gates	3.2.8													
			Swing Gates														
			Vertical Pivot Gates	2.1.5													
			Fence Fabric Reinforcement	2.3													
			SD-07 Certificates														
			Chain Link Fence	2.1.2.1													
			Fabric	2.1.1.1													
			Barbed Wire	2.2.1.2													
			Gate Hardware and Accessories	3.2.1													
			Concrete	2.2.3													
			Gate Operator	2.1.7													
			SD-10 Operation and Maintenance														
			Data														
			Electro-Mechanical Locks	2.1.8													
			Gate Operator	2.1.7													

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		32 31 13.53	Operating and maintenance instructions	3.2.8													
		32 92 19	SD-03 Product Data														
			Wood Cellulose Fiber Mulch	2.5.3													
			Fertilizer	2.4													
			SD-06 Test Reports														
			Topsoil Composition Tests	2.2.3													
			SD-07 Certificates														
			Seed	2.1													
			SD-08 Manufacturer's Instructions														
			Erosion Control Materials	2.7													
		32 93 00	SD-01 Preconstruction Submittals														
			State Landscape Contractor's License	1.4.3													
			Time Restrictions and Planting Conditions	1.6													
			SD-03 Product Data														
			Peat	2.3.5													
			Composted Derivatives	2.3.8													
			Rotted Manure	2.3.11													
			Gypsum	2.3.9													
			Mulch	2.7	G												
			Ground Stakes	2.8.1.2													
			Concrete Edging	2.9.1													
			Fertilizer	2.5													
			Weed Control Fabric	2.6	G												

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		32 93 00	Root Control Barrier	2.12	G												
			Staking Material	2.8.1													
			Antidesiccants	2.10													
			Erosion Control Materials	2.11													
			Photographs	1.4.4	G												
			SD-04 Samples														
			Mulch	2.7	G												
			SD-06 Test Reports														
			Topsoil Composition Tests	2.2.4													
			Percolation Test	1.4.5													
			SD-07 Certificates														
			Nursery Certifications	2.1.1													
			SD-10 Operation and Maintenance														
			Data														
			Plastic Identification	1.8													
		33 11 00	SD-01 Preconstruction Submittals														
			Connections	3.1.1	G												
			SD-03 Product Data														
			Pipe, Fittings, Joints and	2.1.1	G												
			Couplings														
			Valves	2.1.2	G												
			Valve Boxes	2.1.2.5	G												
			Indicator Posts	2.1.2.4	G												
			Fire Hydrants	2.1.3.1	G												
			Pipe Restraint	2.2.1	G												
			Tapping Sleeves	2.2.2	G												

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		33 11 00	Mechanical Couplings	2.2.5	G												
			Insulating Joints	2.2.6	G												
			Tracer Wire	2.2.8	G												
			Corporation Stops	2.2.9.1	G												
			Tapping Saddles	2.2.3	G												
			Backflow Preventor	2.2.4	G												
			Disinfection Procedures	3.2.3	G												
			Compound Type Meters	2.1.4.1													
			SD-06 Test Reports														
			Bacteriological Samples	3.3.1.3	G												
			Hydrostatic Sewer Test	3.2.1.1.6													
			Leakage Test	3.3.1.2													
			Hydrostatic Test	3.3.1.1													
			Backflow Preventer Tests	3.3.1.4													
			SD-07 Certificates														
			Pipe, Fittings, Joints and Couplings	2.1.1													
			Lining	2.1.1.1.1													
			Valves	2.1.2													
			Fire Hydrants	2.1.3.1													
			SD-08 Manufacturer's Instructions														
			Ductile Iron Piping	2.1.1.1													
			Polyethylene (PE) Pipe	2.1.1.2.1													
			Copper Pipe For Service Lines	2.1.1.3													
		33 30 00	SD-01 Preconstruction Submittals														
			Contractor's License	1.3.1	G												

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		33 30 00	SD-02 Shop Drawings														
			Installation Drawings	3.1.1	G												
			SD-03 Product Data														
			Precast Concrete Manholes	2.2.6													
			Frames, Covers, and Gratings	2.2.8													
			Gravity Pipe	2.2.1													
			Pressure Pipe	2.2.2													
			Gaskets	2.2.7													
			SD-06 Test Reports														
			Precast Concrete Sewer Manhole	3.3.1.2.1	G												
			Test														
			Hydrostatic Sewer Test	3.3.1.1	G												
			Negative Air Pressure Test	3.3.1.2.1	G												
			Low-Pressure Air Tests	3.3.1.2.2	G												
			Tests For Pressure Lines	3.3.1.3	G												
			Deflection Testing	3.3.1.4													
			SD-07 Certificates														
			Portland Cement	2.2.4													
			Gaskets	2.2.7													
			Pre-Installation Inspection	3.3.2.1	G												
			Request														
			Post-Installation Inspection	3.3.2.2	G												
		33 31 23.00 10	SD-03 Product Data														
			Ductile Iron Piping	2.2.2													
			PVC Pressure Pipe	2.1.1.1													
			Joints	2.2													

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		33 31 23.00 10	Push-On Joint Fittings	2.2.1.1													
			Flanged Joints	2.2.2.1													
			SD-06 Test Reports														
			Disposal of Waste Water	3.2													
			Final Test Report	3.2													
		33 32 16	SD-02 Shop Drawings														
			Fabrication Drawings	2.1													
			Erection/Installation Drawings	2.1													
			SD-03 Product Data														
			Submersible Sewage Pumps	2.1	G												
			Submersible Sewage Pumps	2.2	G												
			Pump Performance Curve	2.3	G												
			Pump Motor	2.3	G												
			Pump Control System	2.4	G												
			Control Panel	2.4.8	G												
			Pressure Indicating Gauge	2.4.5	G												
			Flow Meter Vault, Wet Well and Valve Vault	2.5	G												
			Valves	2.6	G												
			Spare Parts Data	3.3.1	G												
			Access Hatch Covers	2.5.3	G												
			Tipping Float Switch	2.4.3	G												
			Submersible	2.4.4.3.1	G												
			Transducer/Transmitter														
			Magnetic Flow Measuring Systems	2.4.6	G												

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		33 32 16	SD-05 Design Data														
			Buoyancy Calculations	2.5.2.1	G												
			SD-06 Test Reports														
			Pump Test	3.2.1	G												
			Pressure Sensor Test	3.2.1	G												
			Float Test	3.2.1	G												
			Performance Verification Test (PVT)	3.2.1	G												
			SD-07 Certificates														
			Submersible Sewage Pumps	2.1	G												
			Submersible Sewage Pumps	2.2	G												
			Recycled Material Content	2.5.2.1	G												
			Manhole Chamber	2.1	G												
			Access Hatch Covers	2.5.3													
			Plug Valves	2.6.1	G												
			Check Valves	2.6.2	G												
			Pump Motor	2.3	G												
			SD-08 Manufacturer's Instructions														
			Manhole Chamber	2.1	G												
			Access Hatch Covers	2.5.3													
			Pump Control System	2.4	G												
			Check Valves	2.6.2	G												
			Pump Motor	2.3	G												
			Special Tools	3.3.1	G												
			Posted Instructions	3.3.1	G												

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		33 32 16	SD-10 Operation and Maintenance Data														
			Operation And Maintenance Manuals	3.3.1													
			Training Manual	3.3.1	G												
			SD-11 Closeout Submittals														
			Warranty	1.5	G												
		33 40 00	SD-04 Samples														
			Pipe for Culverts and Storm Drains	2.1													
			SD-07 Certificates														
			Resin Certification	2.1.2													
			Resin Certification	2.1.3													
			Oil Resistant Gasket	2.4.6.1													
			Leakage Test	3.9.1.2													
			Hydrostatic Test on Watertight Joints	3.9.1.1													
			Determination of Density	3.9.1.3													
			Frame and Cover for Gratings	2.4.5													
			Post-Installation Inspection Report	3.9.2.1.3													
			Placing Pipe	3.3													
			SD-11 Closeout Submittals														
			Lid Verification Report	3.9.2.2	G												
		33 51 39	SD-01 Preconstruction Submittals														

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		33 51 39	Investigation-derived Waste Management Plan	1.5.3	G												
			Installation Plan	1.5.5	G												
			Health and Safety Plan	1.5.4	G												
			Treatment, Storage, and Disposal Facility Permit	1.5.6													
			Qualifications	1.5.1	G												
			SD-02 Shop Drawings														
			Survey Maps and Notes	3.3.4.1	G												
			Well Construction Drawings	1.5.2	G												
			SD-03 Product Data														
			Riser Pipe	1.1	G												
			Cement	1.1	G												
			Surface Protective Covers	1.1	G												
			Well Vaults	1.1	G												
			Locking Caps	1.1	G												
			Well Casing	2.2.1	G												
			Well Screen	2.2.2	G												
			Filter Pack	1.1	G												
			Neat Cement Grout	2.2.4.2	G												
			Bentonite	2.2.4.1	G												
			SD-06 Test Reports														
			Well Development Record	3.3.3.1	G												
			Water Source Analytical Test Results	3.1.1	G												
			SD-07 Certificates														

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		33 51 39	Permits	1.7													
			Installation Survey Report	3.3.4													
			Well Development Report	1.5.7													
			Shipment Manifests	1.5.8													
			Delivery Certificates	1.5.9													
			Correspondence	1.7													
			Photographs	3.3.5													
			Treatment and Disposal Certificates	1.5.10													
			SD-11 Closeout Submittals														
			Installation Diagram	3.5.2.2	G												
			Well	3.5.3													
			Decommissioning/Abandonment Record														
			Geophysical Logs														
			Borehole Logs	3.5.2.1	G												
		33 71 02	SD-02 Shop Drawings														
			Precast underground structures	1.5.1	G												
			SD-03 Product Data														
			Medium voltage cable	2.5	G												
			Medium voltage cable joints	2.7	G												
			Medium voltage cable terminations	2.6	G												
			Precast concrete structures	2.13.2.1	G												
			Sealing Material	2.13.2.4													
			Pulling-In Irons	3.5.3													

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		33 71 02	Landslide Manhole frames and covers	2.13.3	G												
			Handhole frames and covers	2.13.6	G												
			Composite/fiberglass handholes	2.13.8	G												
			Cable supports	2.14	G												
			SD-06 Test Reports														
			Medium voltage cable qualification and production tests	2.16.2	G												
			Field Acceptance Checks and Tests	3.19.1	G												
			Arc-proofing test	2.16.1	G												
			Cable Installation Plan and Procedure	3.3	G												
			SD-07 Certificates														
			Cable splicer/terminator	1.5.2	G												
			Cable Installer Qualifications	1.5.3	G												
		33 82 00	SD-02 Shop Drawings														
			Telecommunications Outside Plant	1.6.1.1	G												
			Telecommunications Entrance Facility Drawings	1.6.1.2	G												
			Outdoor telecommunications enclosures	2.14	G												
			SD-03 Product Data														
			Wire and cable	2.7	G												
			Cable splices, and connectors	2.4	G												

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 82 00	Closures	2.3	G												
			Building protector assemblies	2.2.1	G												
			Protector modules	2.2.2	G												
			Outdoor telecommunications enclosures	2.14	G												
			Outdoor telecommunications cabinet	2.13	G												
			SD-06 Test Reports														
			Pre-installation tests	3.5.1	G												
			Acceptance tests	3.5.2	G												
			Outside Plant Test Plan	1.6.3	G												
			SD-07 Certificates														
			Telecommunications Contractor	1.6.2.1	G												
			Key Personnel	1.6.2.2	G												
			Manufacturer's Qualifications	1.6.2.3	G												
			SD-08 Manufacturer's Instructions														
			Building protector assembly installation	2.2.1	G												
			Cable tensions	3.1.6.1	G												
			Fiber Optic Splices		G												
			SD-09 Manufacturer's Field Reports														
			Factory Reel Test Data	2.12.1	G												
			SD-10 Operation and Maintenance Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
NOAA OMAO Ship & Support Facility Relocation

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 82 00	Telecommunications outside plant (OSP)	1.6.1.1	G												
			SD-11 Closeout Submittals														
			Record Documentation	1.8.1	G												
		34 71 13.16	SD-03 Product Data														
			FHWA Acceptance Letter	2.1.3													
			FHWA Acceptance Letter	2.5													
			SD-08 Manufacturer's Instructions														
			End Anchorage	3.4													
			Crash Cushion	3.5													
		35 51 13	SD-01 Preconstruction Submittals														
			Quality Control Procedures	1.6	G												
			Contractor Qualifications	1.6.1.2													
			Manufacturer Qualifications	1.6.1.1													
			SD-02 Shop Drawings														
			Floating Dock System	1.8.1	G												
			Reinforcing Steel	1.8.1													
			Gangways	1.8.1	G												
			Utility Routing	1.8.1	G												
			All-Purpose Pedestals	1.8.1	G												
			All-Purpose Pedestals	2.7	G												
			Receptacle Stations	1.8.1	G												
			Receptacle Stations	2.6	G												
			SD-03 Product Data														
			Concrete Mix Design	1.8.4	G												
			Concrete Mix Design	2.4.1	G												

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CONTRACTOR

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		35 51 13	Grout	2.4.2	G												
			Reinforcement	2.4.3	G												
			Metal Accessories	2.4.4	G												
			Cleats	2.4.8.1	G												
			Dock Fenders	2.4.8.2	G												
			Ladders	2.4.8.3													
			Gangway Materials	2.5													
			Receptacle Stations	1.8.1	G												
			Receptacle Stations	2.6	G												
			All-Purpose Pedestals	1.8.1	G												
			All-Purpose Pedestals	2.7	G												
			Concrete Curing	3.1.6													
			Guide Pile Rub Blocks And Rollers	2.4.8.4	G												
			SD-05 Design Data														
			Floating Dock System Design Calculations	1.8.2	G												
			Gangway Calculations	1.8.2	G												
			Concrete Mix Design	1.8.4	G												
			Concrete Mix Design	2.4.1	G												
			SD-06 Test Reports														
			Concrete Mix Design	1.8.4													
			Concrete Mix Design	2.4.1													
			Fasteners	2.5.2													
			Reinforcement	2.4.3													
			Metal Accessories	2.4.4													

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CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REVIEW / ACTION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		35 51 13	Foam Core	2.4.5													
			Coatings	3.7	G												
			SD-07 Certificates														
			Float Fabrication	3.1													
			Rubbing Surface	2.4.8.4													
			Paint Coating System	2.6.1	G												
			SD-10 Operation and Maintenance Data														
			Floating Dock System Operation And Maintenance Manual	3.2	G												
			SD-11 Closeout Submittals Warranty	1.9													
		35 59 13.19	SD-03 Product Data														
			Arch Fender	2.1													
			Hardware	2.3													
			Unit Fender	2.1													
			SD-05 Design Data														
			curve	2.4.1													
			Dimension	2.1													
			Arch Fender	2.1													
			Unit Fender	2.1													
			Design	2.1													
			Design	2.1													
			SD-06 Test Reports														
			Minimum Tensile Strength	2.2													
			Shore Hardness (Durometer)	2.2													

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	CLASSIFICATION GOVT OR A/E REVIEWER	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		35 59 13.19	Modulus at 400 Percent	2.2													
			Elongation														
			Maximum Compression Set	2.2													
			Tear Resistance	2.2													
			Minimum Elongation	2.2													
			Ozone Resistance	2.2													
			Low Temperature Impact	2.2													
			Resistance														
			Water Absorption	2.2													
			Heat Resistance	2.2													
			Compression Deflection	2.2													
			Resistance														
			Fender Compression Test	2.4.1													
			SD-08 Manufacturer's Instructions														
			Installation	3.1													
		35 59 20	SD-01 Preconstruction Submittals														
			Installation Plan	1.4.1	G												
			SD-02 Shop Drawings														
			HDPE Sleeves	2.1	G												
			SD-03 Product Data														
			HDPE Sleeves	2.1	G												
			Underwater High-Strength Grout	2.2	G												
			SD-06 Test Reports														
			Test Pile Sleeve Installation	3.2	G												
			Underwater High-Strength Grout	2.2	G												
			SD-11 Closeout Submittals														

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NOAA OMAO Ship & Support Facility Relocation

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I O N W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		35 59 20	Inspection Report	3.3													
		35 59 35	SD-02 Shop Drawings														
			Bolts, Nuts, and Washers	2.2.3	G												
			Mooring Bollards	2.2.1.1	G												
			SD-03 Product Data														
			Paint System	2.3.2.2	G												
			Marine Grade Silicone Sealant	3.1.1	G												
			Nonshrink Grout	2.2.4.2	G												
			SD-05 Design Data														
			Mooring Bollard Design	2.1	G												
			Calculations														
			SD-06 Test Reports														
			Bolts, Nuts, and Washers	2.2.3													
			SD-07 Certificates														
			Qualifications	1.3.1	G												
			Mooring Bollards	2.2.1.1	G												
			Bolts, Nuts, and Washers	2.2.3	G												
			Paint System	2.3.2.2	G												
			Non-Shrink Grout	2.2.4.2	G												
			Galvanizing	2.3.1	G												
		40 05 13	SD-02 Shop Drawings														
			Materials and Equipment	2.2													
			Installation Drawings	2.2.3	G												
			SD-03 Product Data														
			Qualifications	1.4													
			Waste Water Disposal	3.16													

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CONTRACTOR

[illegible]

SECTION 01 33 29

SUSTAINABILITY REQUIREMENTS AND REPORTING

02/21

PART 1 GENERAL

1.1 INTRODUCTION

This project is designed and must be constructed to meet the Department of Defense Guiding Principles (GP) as outlined in UFC 1-200-02. The Administration/Warehouse (A/W) Building requires tracking of the GP via a High Performance and Sustainable Building (HPSB) checklist as well as Third Party Certification (TPC) via USGBC's LEED version 4/4.1, Building Design and Construction at the Silver level. Refer to project specific HPSB and LEED checklists in appendices to this section.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

COUNCIL ON ENVIRONMENTAL QUALITY (CEQ) (WHITE HOUSE)

HPSB Guiding Principles	(2016) Guiding Principles for Sustainable Federal Buildings and Determining Compliance with the Guiding Principles for Sustainable Federal Buildings
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FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	(2015) Principles and Criteria for Forest Stewardship
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INTERNATIONAL CODE COUNCIL (ICC)

ICC IGCC	(2018) International Green Construction Code
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U.S. DEPARTMENT OF AGRICULTURE (USDA)

FSRIA 9002	Farm Security and Rural Investment Act Section 9002 (USDA BioPreferred Program)
------------	--

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 1-200-02	(2020; with Change 1, 2020) High Performance and Sustainable Building Requirements
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UFC 3-600-01	(2020; with Change 5) Fire Protection Engineering for Facilities
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U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247

Comprehensive Procurement Guideline for
Products Containing Recovered Materials

1.3 SUMMARY

This section includes requirements for Sustainability documentation and reporting submittals per the federally mandated High Performance and Sustainable Building (HPSB) or HPSB "Guiding Principles" (GP), and Third Party Certification (TPC) requirements, in accordance with UFC 1-200-02 High Performance and Sustainable Building Requirements, and for additional product performance/ documentation requirements for LEED v4/v4.1 Building Design and Construction certification at the Silver level. .

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Preliminary Sustainability eNotebook; S

In-Progress Sustainability eNotebook; S

SD-11 Closeout Submittals

Final Sustainability eNotebook; S

Amended Final Sustainability eNotebook; S

1.5 SUSTAINABILITY SUBMITTALS

Provide documentation in the Sustainability eNotebook to indicate compliance with the sustainability requirements of the project.

1.5.1 Sustainability eNotebook

The Sustainability eNotebook is an electronic organizational file that serves as a repository for all required sustainability submittals. To support documentation of compliance with an approved HPSB and TPC checklists, provide and maintain a comprehensive and current Sustainability eNotebook. Include all required data in Sustainability eNotebook, to support full compliance with the HPSB Guiding Principles Requirements, including:

- a. Checklists (HPSB and TPC)
- b. Sustainability Action Plan (see below section for requirements of this plan)
- c. "S" submittals, as indicated throughout project applicable specifications.
- d. Provide all construction related documentation, including

calculations, product data, labels and product certifications required to demonstrate compliance with the sustainability requirements.

- e. Final Sustainability eNotebook: TPC Award Certificate, assessment or validation and compliance report that includes level achieved and reasons for non-compliance or not applicable elements.

Sustainability eNotebook to be kept updated with regularly-scheduled Construction Quality Control Meetings.

1.5.1.1 High Performance Sustainable Building (HPSB) and Third Party Certification (TPC) Checklist

Provide construction documentation that provides proof of, and supports compliance with, the completed Checklists.

Submit updated Checklists with each Sustainability eNotebook submittal. Include final Checklists with the interim DD1354 Real Property Record submittal.

1.5.1.2 Sustainability Action Plan

Include the following information in the Sustainability Action Plan:

- a. Planned method to achieve each applicable GP requirements. Provide documentation illustrating compliance with requirements. Final government approved narrative(s) must be included in the HPSB Checklist submittal.
- b. Planned method to achieve each identified LEED credit. Provide documentation illustrating compliance with requirements including all completed TPC forms. TPC forms are to be approved by Contracting Officer prior to contractor submitting to the TPC organization. TPC forms to be transmitted by the method required by TPC organization. Include copies of all correspondence with TPC organization.
- c. Name and contact information for: Contractor's Point of Contact (POC) ensuring sustainability goals are accomplished and documentation is assembled.
- d. Indoor Air Quality plan.

1.5.1.3 "S" Submittals for Sustainability Documentation

"S" submittals are the sustainability documentation requirements cited in the various sections of this contract. Submit the GPV and TPC sustainability documentation required in this section as "S" submittals in all affected UFGS Sections.

- a. Highlight GPV and TPC compliance data in "S" submittal.
- b. Add "S" submittals to the Sustainability eNotebook only after submittal approval, and bookmark them as required in paragraph SUSTAINABILITY ENOTEBOOK below.
- c. Ensure all approved "S" submittals are included in each Sustainability eNotebook submittal.

1.5.1.4 Sustainability eNotebook Format

Provide Sustainability eNotebook in the form of an Adobe PDF file; bookmark each HPSB Guiding Principles Requirement, TPC requirement (LEED credit), and sub-bookmark at each document. Match format to HPSB Guiding Principles numbering system indicated herein. Maintain up-to-date information, such as spreadsheets, templates, with each current submittals. For TPC projects, provide a second Table of Contents using TPC numbering system, for maintaining documentation unique to TPC.

Contracting Officer may deduct from the monthly progress payment accordingly if Sustainability eNotebook information is not current and on track per project goals.

1.5.1.5 Sustainability eNotebook Submittal Schedule

Provide Sustainability eNotebook Submittals at the following milestones of the project:

a. Preliminary Sustainability eNotebook

Submit preliminary Sustainability eNotebook with updated Preliminary High Performance and Sustainable Building Checklist and TPC checklist at the first post award meeting in accordance with Section 01 30 00 ADMINISTRATIVE REQUIREMENTS.

b. In-Progress Sustainability eNotebook

Submit updated Sustainability eNotebook with updated High Performance and Sustainable Building Checklist with TPC Checklist and required related documentation to be submitted for LEED review. If issues relating to achieving the sustainability goals of the project are subsequently identified, identify reasons and mitigation from DOR, and resubmit to the Contracting Officer for approval.

c. Third Party Certification Compliance Report

Obtain Third Party Certification Compliance Report after final Sustainability eNotebook submittal is approved. Report must indicate 100 percent compliance with applicable LEED requirements. File approved submittal in the Sustainability eNotebook.

d. Construction Quality Control Meetings.

Provide up-to-date GP and TPC documentation in the Sustainability eNotebook for each meeting.

e. Final Sustainability eNotebook

Submit updated Sustainability eNotebook with updated Final High Performance and Sustainable Building Checklist with TPC Checklist, in accordance with Section 01 33 00 SUBMITTAL PROCEDURES at Beneficial Occupancy Date (BOD). Final progress payment retainage may be held by Contracting Officer until Final Sustainability construction phase documentation is complete.

f. Amended Final Sustainability eNotebook

Amend and resubmit the Amended Final Sustainability eNotebook with

Amended Final High Performance and Sustainable Building Checklist and amended TPC Checklist, to include post-occupancy corrections, updates, and requirements. Final progress payment retainage may be held by Contracting Officer until amended final sustainability documentation is complete. Submit the Amended Final Sustainability eNotebook Submittal on DVDs to the Contracting Officer no later than 30 days after final GP, TPC determination.

1.6 GUIDING PRINCIPLES (GP) VALIDATION

This project has been designed for and must be constructed to achieve applicable GP as outlined in the HPSB Checklist at the end of this specification section.

Complete all construction work to incorporated applicable GP requirements. Maintain constructed related information in the Sustainability eNotebook, updated regularly. Include information pertaining to additions and changes to the applicable GP requirements.

No changes to the HPSB Checklist are allowed without approval from the Contracting Officer, in accordance with Section 01 33 00 SUBMITTAL REQUIREMENTS. Immediately bring to the attention of the Contracting Officer any project changes that impact meeting the applicable GP requirements for this project. Demonstrate that any change will not increase the life-cycle cost and maintains or improves the building performance.

1.7 GUIDING PRINCIPLE VALIDATION (GPV) DOCUMENTATION REQUIREMENTS

- a. Incorporate each of the following HPSB Guiding Principles requirements into project and provide documentation that proves compliance with each listed requirement. Items below are organized by HPSB Guiding Principles. For life-cycle cost analysis requirements, one document with all analyses is acceptable, with Contracting Officer approval.
- b. For each of the following paragraphs that require the use of products listed on Government-required websites, provide documentation of the process used to select products, or process used to determine why listed products do not meet project performance requirements.

1.7.1 Commissioning (Cx)

Develop and incorporate Commissioning requirements into the documents, in accordance with Section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING.

1.7.2 Energy Efficient Products

Provide only energy-using products that are Energy Star rated or have Federal Energy Management Program (FEMP) recommended efficiency. Where Energy Star or FEMP recommendations have not been established, provide most efficient products that are life-cycle cost-effective. Provide only energy using products that meet FEMP requirements for low standby power consumption. Energy efficient products can be found at:
<https://www.energy.gov/eere/femp/federal-energy-management-program> and
<http://www.energystar.gov/>.

For construction submittal documentation, provide proof that product is labeled energy efficient and complies with the cited requirements.

1.7.3 Building-level Power Metering

Provide building-level meters for electricity, natural gas, and steam where applicable.

1.7.3.1 Construction Submittal Documentation

Provide manufacturer's data validating compatibility with base-wide system and component advanced meter requirements.

1.7.4 Indoor Water Use

Provide Construction Documentation proof that fixtures are labeled EPA WaterSense, for products available with EPA WaterSense labeling; for all other fixtures, proof they comply with EPA WaterSense efficiency requirements.

1.7.5 Indoor Water Metering

Provide building-level meters for potable water use. Provide the requirements cited in the following paragraphs:

1.7.5.1 Construction Submittal Documentation

Provide manufacturer's data validating compatibility with base-wide system and component advanced meter requirements.

1.7.6 Moisture Control

Provide the following:

1.7.6.1 Construction Submittal Documentation

Ensure construction materials are separated and protected in accordance with other sections in this contract document, with adequate humidity controls during construction. In accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, includes plan for ongoing building moisture control.

Coordinate with the moisture control requirements of Section 01 45 00.00 20 QUALITY CONTROL.

1.7.7 Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials)

Meet the requirements of Table 3-1 at the end of this specification.

For Construction submittal documentation, provide certifications or labels that demonstrate compliance with cited requirements, based on the attached TABLE 3-1.

1.7.8 Indoor Air Quality During Construction

Prior to construction, create indoor air quality plan. Develop and implement an IAQ construction management plan during construction and flush building air before occupancy.

For new construction and for renovation of unoccupied existing buildings, meet the requirements of ICC IGCC 1001.3.1.5 (10.3.1.4) Indoor Air Quality

(IAQ) Construction Management. Coordinate with moisture control requirements in Section 01 45 00.00 20 Quality Control.

Provide documentation showing that after construction ends and prior to occupancy, HVAC filters were replaced and building air was flushed out in accordance with the cited standard.

1.7.9 Recycled Content

Comply with 40 CFR 247. Refer to:
<https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program>
for assistance identifying products cited in 40 CFR 247. Selected products must comply with non-proprietary requirements of the Federal Acquisition Regulation and must meet performance requirements.

1.7.9.1 Construction Submittal Documentation

- a. Provide manufacturers' documents stating the recycled content by material, or written justification for claiming one of the exceptions allowed on the cited website.
- b. Substitutions: Submit for Government approval for proposed alternative products or systems that provide equivalent performance and appearance and have greater contribution to project recycled content requirements. For all such proposed substitutions, submit with the Sustainability Action Plan accompanied by product data demonstrating equivalence.
- c. In order to complete compliance with FAR 52.223-9 Estimate of Percentage of Recovered Material Content for EPA Designated Items, refer to submittal requirement for recycled/recovered material content in Section 01 78 00 CLOSEOUT SUBMITTALS.

1.7.10 Bio-Based Products

Provide products and materials composed of the highest percentage of bio-based materials (including rapidly renewable resources and certified sustainably harvested products), consistent with FSRIA 9002 USDA BioPreferred Program, to the maximum extent possible without jeopardizing the intended end use or detracting from the overall quality delivered to the end user and when available at a reasonable cost. Use only supplies and materials of a type and quality that conform to applicable specifications and standards.

Comply with FSRIA 9002 USDA BioPreferred Program. Refer to www.biopreferred.gov for the product categories and BioPreferred Catalog. Selected products must comply with non-proprietary requirements of the Federal Acquisition Regulation and must meet performance requirements. Provide the following documentation:

- a. USDA BioPreferred label for each product; for bio-based products used on project but not listed with BioPreferred program, provide bio-based content and percentage.
- b. In order to complete compliance with FAR 52.223-1 Biobased Product Certification, refer to submittal requirement for biobased products in Section 01 78 00 CLOSEOUT SUBMITTALS, paragraphs CERTIFICATION OF EPA DESIGNATED ITEMS and CERTIFICATION OF USDA DESIGNATED ITEMS.

1.7.11 Waste Material Management (Recycling - Construction)

Divert demolition and construction debris in accordance with Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

1.8 THIRD PARTY CERTIFICATION (TPC)

This project has been designed for, and must be constructed to achieve LEED v4 (v4.1 for specific LEED credits where indicated) BD+C to level Silver certification as outlined in the LEED Checklist at the end of this specification section. Project is registered with the TPC Organization and a design review in progress/completed by the A/E. Request TPC on-line access turnover from Contracting Officer. LEED credit information can be found at usgbc.org/credits.

No changes to the LEED Checklist are allowed without approval from the Contracting Officer, in accordance with Section 01 33 00 SUBMITTAL REQUIREMENTS. Immediately bring to the attention of the Contracting Officer any project changes that impact meeting the applicable GP requirements for this project. Demonstrate that any change will not increase the life-cycle cost and maintains or improves the building performance.

For each TPC requirement that is attempted but not achieved, provide narrative explaining how mission or activity precludes achieving specific sustainability requirement or goal. Provide analysis of particular requirement and level to which project is able to comply.

Complete all construction work to incorporated applicable LEED credits. Manage and provide all documentation for requirements of TPC. Maintain constructed related information in the Sustainability eNotebook, updated regularly. Include information pertaining to additions and changes to applicable LEED requirements. Third Party Certification is met when Government receives TPC organization certificate, assessment, or validation and compliance report and plaque.

Contractor to bear all costs associated with construction changes that affect sustainability design requirements, constructing, demonstrating, and documenting that project complies with approved TPC requirements, including but not limited to:

- (1) Final TPC review, certification, assessment, or validation and plaque fees.
- (2) Online TPC management and documentation.
- (3) Obtaining TPC certification or validation based on Government-approved sustainability goals.
- (4) Construction work required to incorporate TPC requirements.
- (5) Submittals required to demonstrate compliance with Government approved TPC checklists.

Contractor to provide all required responses to third party organization.

Provide TPC Plaque and Certificate. Use format below to create the Plaque, Certificate, assessment or validation, compliance report, and Letter of Congratulations (when provided). Forward to parties designated by Contracting Officer:

- (1) Plaque:
Name: Final Building Name. If unknown, provide Form DD1391 Project

Name.

- (2) Certificate, Assessment or Validation:
Project Title, first line: P-(X); Form DD1391 Project Name).
Project Title, second line: UIC (Installation code)
- (3) Letter Congratulations (when provided):
Address letter to Facility's Installation Commander Name. Address the letter to an individual person.
- (4) Compliance Report:
Title page must cite Project title: P-(X); (1391 Project Name); Final Building Name if known;
UIC (installation code); Owner Service; User organization if known;
date of compliance.
Include TPC scoresheet if applicable.

1.9 THIRD PARTY CERTIFICATION (TPC) DOCUMENTATION REQUIREMENTS

Incorporate each of the TPC construction credit requirements identified in the attached checklists into project and provide documentation that proves compliance with each requirement. Should a GP and LEED requirement overlap, the more stringent of the two shall be adhered to.

It is the contractors responsibility to verify that LEED construction credits are met in full. Contractor to source products that meet requirements not included in individual specification sections as required to meet credit. See additional credit information at usgbc.org.

Provide a list of products meeting each applicable LEED credits in the Preliminary Sustainability eNotebook. The contractor must verify that each LEED credit is achieved via calculations and/or other documentation as required for each LEED credit in the Final Sustainability eNotebook.

1.9.1 SS Construction Activity Pollution Prevention

Meet LEED v4 requirements for this credit by developing and implementing an erosion and sedimentation control plan for all construction activities associated with the project.

1.9.2 E&A Fundamental Commissioning and Verification

Meet LEED v4 requirement for this credit. Refer to specification section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING.

1.9.3 E&A Enhanced Commissioning

Meet LEED v4.1 requirement for this credit. Refer to specification section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING.

1.9.4 E&A Green Power and Carbon Offsets

Meet LEED v4.1 requirement for this credit by purchasing energy from green power or carbon offsets for 50% of the total annual energy consumption of the building and site (within the project boundary). See the HPSB Checklist appendix to this specification section for the calculated building EUI.

1.9.5 M&R Construction and Demolition Waste Management Planning

Meet LEED v4 requirement for this credit by developing and implementing a

construction and demolition waste management plan.

1.9.6 M&R Environmental Product Declarations (EPD)

Meet LEED v4.1 requirements for this credit and Exemplary Performance identified on the attached LEED checklist by providing products including a min of 40 different permanently installed products sourced from a minimum of 5 different manufacturers that each meet one of the options under option 1 in LEED credit M&R Environmental Product Declarations.

1.9.7 M&R Sourcing of Raw Materials

Meet LEED v4.1 requirements for this credit by at a minimum use products sourced from at least 3 different manufacturers that meet at least one of the LEED responsible sourcing and extraction criteria for at least 15%, by cost, of the total value of permanently installed building products in the project.

Responsible sourcing and extraction criteria cited in the specifications:

- a. Extended Producer Responsibility - Purchase products from a manufacturer (producer) that participates in an extending producer responsibility program (aka EPR or Take-Back Program) or is directly responsible for extended producer responsibility. Submit documentation of manufacturer's maintenance agreement and take-back program, service must reclaim materials for recycling and/or reuse. Include contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and reuse. Set aside product, full and partial, scrap and packaging to be returned to manufacturer for recycling into new product.
- b. Wood Products - Wood products must be certified by the Forest Stewardship Council (FSC). Provide letter of certification signed by lumber supplier/vendor. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers.
- c. Recycled Content - Provide products with recycled content as indicated in specification sections or required to meet LEED credit criteria.
- d. Regional Materials - Provide products sourced within 100 miles of the project site to the greatest extent possible to assist in achieving credit requirements. Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

1.9.8 M&R Material Ingredient Optimization

Meet LEED v4.1 requirements for this credit by, at a minimum, providing 5 permanently installed products sourced from a minimum of 3 different manufactures that have a compliant material ingredient optimization report or action plan meeting one of the options under option 2 in LEED credit M&R Material Ingredient Optimization.

1.9.9 M&R Construction and Demolition Waste Management

Meet LEED v4 requirement for this credit. Refer to specification section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

1.9.10 IEQ Low Emitting Materials

Meet LEED v4.1 requirements for this credit and Exemplary Performance by providing products, within the building interior (anything within the air barrier) that meet the LEED low-emitting criteria product categories as necessary to achieve indicated LEED credits. The contractor must verify that all products within each category comply with the LEED credit criteria.

- a. VOC Emissions Evaluation: VOC emissions must meet the California Department of Public Health (CDPH) Standard Method v1.2-2017, using the applicable exposure scenario.
- b. VOC Content Evaluation: VOC content must meet one of the standards listed under this credit for Paints and Coatings and Adhesives and Sealants.
- c. Formaldehyde Emissions Evaluation: Composite wood must be certified as ultra-low-emitting formaldehyde (ULEF) product under EPA Toxic Substances Control Act, Formaldehyde Emissions Standards for Composite Wood Products (TSCA, Title VI) (EPA TSCA Title VI) or California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM).
- d. Furniture Emissions Evaluation: Furniture must be tested in accordance with ANSI/BIFMA Standard Method M7.1-2011 (R2016) and complies with ANSI/BIFMA e3-2014e or e3-2019e Furniture Sustainability Standard. Laboratories that conduct the tests must be accredited under ISO/IEC 17025 for the test methods they use. Statement of product compliance must include exposure scenario.

1.9.11 IEQ Construction Indoor Air Quality Management Plan

Meet LEED v4 requirement for this credit by developing and implementing an indoor air quality (IAQ) management plan for the construction and pre-occupancy phases of the building to comply with LEED credit criteria.

1.9.12 IEQ Indoor Air Quality Assessment

Meet LEED v4.1 requirements for this credit including providing Air Testing for particulate matter (PM) and inorganic gases as well as volatile organic compounds (VOC's). Provide before occupancy flush-out to assist air testing. Contractor must provide materials meeting Low Emitting Material VOC emissions evaluation within the weatherproofing system as required to meet this credit. Refer to specification 23 30 00 for additional information.

1.9.13 Innovation - Lamp Purchasing

Meet LEED v4 requirement for this credit by developing and implementing a lighting purchasing plan that specifies an overall building average of 70 picograms of mercury per lumen-hour or less for all mercury-containing lamps purchased for the building and associated site within the project boundary. LED's, or lamps containing no mercury may be counted if their energy efficiency at least equals that of their mercury-containing

counterparts.

1.9.14 Pilot Credit - Legal Wood

Meet LEED v4.1 requirements for this pilot credit by providing all wood from legal sources and 70% of wood (based on cost) from responsible sources. Legal and responsible sources must be as defined by ASTM D7612-10. Components to include, but not be limited to, general framing, wood doors, concrete wood forms and applicable finishes.

1.9.15 Innovation - LEED Accredited Professional

Meet LEED v4 requirement for this credit by providing a minimum of one principal project team participant that is a LEED Accredited Professional (AP) with a BD+C specialty.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 SUSTAINABILITY COORDINATION

Provide sustainability focus and coordination at all meetings to achieve sustainability goals. Coordinate meeting requirements with other UFGS Sections meeting requirements in this project. Ensure the designated TPC accredited sustainability professional responsible for GP and TPC documentation participates in these meetings to coordinate documentation completion. Review GP and TPC sustainability requirements, HPSB Checklist and TPC documentation, Sustainability Action Plan, and completeness status of Sustainability eNotebook, and TPC status at the following meetings:

- a. Pre-Construction Conference
- b. Construction Quality Control Meetings

Refer to Section 01 30 00 ADMINISTRATIVE PROCEDURES for Post Award Meetings.

- c. Facility Turnover Meetings

Conduct review no later than 60 days before final turnover and identify any outstanding issues that affect correct completion of all documentation and final TPC certification, assessment or validation, and actions that will achieve requirements. Conduct corrective actions prior to turnover, to ensure all requirements are achieved.

3.2 THIRD PARTY CERTIFICATION CERTIFICATE, ASSESSMENT, OR VALIDATION AND COMPLIANCE REPORT

Finalize the process requirements and obtain the TPC Plaque and Certificate, assessment, or validation, and compliance report, indicating completion of the project's sustainability goals. Include TPC compliance report with final TPC scoresheet as applicable.

Provide one original framed copy of the certificate, assessment, or validation, mounted in 1 inch deep metal frames, with double matt, and wire hangers, in location approved by Contracting Officer. Deliver one

original certificate, assessment, or validation, and compliance report to Contractor Officer, unless otherwise instructed. Provide and hang Plaque in a prominent interior location approved by the Contracting Officer.

3.3 TABLE 3-1 VOLATILE ORGANIC COMPOUNDS (VOC) (LOW EMITTING MATERIALS) REQUIREMENTS

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements				
Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)				
MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Adhesives and Sealants	CDPH/EHLE/Standard method V1.1 (California Section 01350) (Use "office" or "classroom" space limits for all applications)	or	Adhesives (carpet, resilient, wood flooring; base cove; ceramic tile; drywall and panel; primers) Sealants (acoustical; firestop; HVAC Air duct; primers) Caulks	SCAQMD Rule 1168 (Use "other" category for HVAC duct sealant) (for firestop adhesive, UFC 3-600-01 overrides conflicting requirements)
			Aerosol adhesives	Section 3 of Green Seal Standard GS-36 (except: cleaners, solvent cements, and primers used with plastic piping and conduit in plumbing, fire suppression, and electrical systems; HVAC air duct sealants when the application space air temp is less than 40 F (4.5 C).

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements				
Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)				
MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Paints and Coatings	CDPH/EHLB/Standard method VI.1 (California Section 01350) (Use "office" or "classroom" space limits for all applications)	or	Flat and nonflat, nonflat high-gloss, specialty, basement specialty, fire-resistive, floor, low-solids, rust preventative, wood, reflective wall coatings; concrete/masonry sealers; primers; sealers; undercoaters; shellacs (clear and opaque); stains; varnishes; conjugated oil varnish; lacquer; clear brushing lacquer	Green Seal Standard GS-11

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)				
MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Paints and Coatings	CDPH/EHLB/Standard method V1.1 (California Section 01350) (Use "office" or "classroom" space limits for all applications)	or	Concrete curing compounds; dry fog, faux finishing, graphic arts (sign paints), industrial maintenance, mastic texture, metallic pigmented, multicolor, recycled coatings; pretreatment wash primers, reactive penetrating sealers; specialty primers, wood preservatives, and zinc primers	California Air Resources Board (CARB) Suggested Control Measure for Architectural Coatings or SCAQMD Rule 1113r
Paints and Coatings	CDPH/EHLB/Standard method V1.1 (California Section 01350) (Use "office" or "classroom" space limits for all applications)	or	High-temperature coatings; stone consolidants; swimming-pool coatings; tub- and tile-refining coatings; and waterproofing membranes	California Air Resources Board (CARB) Suggested Control Measure for Architectural Coatings

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements				
Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)				
MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Floor Covering Materials	For carpet, all locations: CDPH/EHLB/Standard Method V1.1 (California Section 01350) or label for Section 9 of CDPH/EHLB/Standard Method V1.1 (California Section 01350)		none	none
Insulation	CDPH/EHLB/Standard method V1.1 (California Section 01350) (Use "office" or "classroom" space limits for all applications)		none	none

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements				
Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)				
MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Composite Wood, Wood Structural Panel, and Agrifiber Products, no added urea-formaldehyde resins including laminating adhesives for composite wood and agrifiber assemblies - particleboard, medium density fiberboard (MDF), wheatboard, strawboard, panel substrates, door cores	Third-party certification (approved by CARB) of California Air Resource Board's (CARB) regulation, Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products	or	none	CDPH/EHLB/Standard method V1.1 (California Section 01350) (Use "office" or "classroom" space limits for all applications) (except: Structural panel components such as plywood, particle board, wafer board, and oriented strand board identified as "EXPOSURE 1," "EXTERIOR," or "HUD-APPROVED" are considered acceptable for interior use.)
Office Furniture Systems and Seating installed prior to occupancy	ANSI/BIFMA X7.1 ANSI/BIFMA X7.1: (95-percent of installed office furniture system workstations and seating units) Section 7.6.2 of ANSI/BIFMA e3 (50-percent of office furniture system workstations and seating units)		none	none

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements				
Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)				
MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Ceiling and Wall assemblies and systems including: acoustical treatments; ceiling panels and tiles; tackable wall panels and coverings; wall coverings; wall and ceiling paneling and planking	CDPH/EHLB/Standard method V1.1 (California Section 01350) (Use "office" or "classroom" space limits for all applications)		none	none

-- End of Section --

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NAVFAC HIGH PERFORMANCE AND SUSTAINABLE BUILDING CHECKLIST -- GOALS

PROJECT INFORMATION

Work Order No.: _____ FY _____ MILCON P No. / Customer Reference No.: _____
Project Title: _____
Location UIC/Name: _____
NAVFAC Project Manager: _____ Project Design Level: _____
Facility Area: _____ U/M: _____ Category Code: _____ Facility #: _____
AE Contract # & T.O. _____ AE Firm Sustainability Coordinator: _____
AE Firm Name: _____
Project Phase: _____ Design Start / PDA _____ Solicitation Documents Complete _____
Construction Contract _____ Award Date (P): _____ BOD (P): _____

SUSTAINABILITY DATA - GUIDING PRINCIPLES for SUSTAINABLE DEVELOPMENT

Use this form to collect Design Goals information to be recorded on the Sustainable and Energy Tab in eProjects

NOTE: 1. Mark "N/A" only when at least one of the listed justifications is applicable, and mark those justifications. Otherwise, mark "Yes."
2. If project is for more than one building for which tracking is required, complete a separate form for each building.

PRELIMINARY PROJECT INFORMATION

- 1 How many buildings are included in this project? _____
- 2 Does at least one building meet one of the following: 1) new construction (new building or addition to existing);
- OR - 2) Renovation in an existing building, with construction cost greater than \$3M? _____ Yes _____ No
- 3 Identify the building to be tracked in this tab: _____

DESIGN DEVELOPMENT - DOCUMENTATION OF COMPLIANCE WITH GUIDING PRINCIPLES

I. Employ Integrated Design Principles

1 Integrated Design

Goals In Compliance _____ Yes _____ N/A
N/A due to
_____ Mission preclusion _____ Building/site issue
_____ Not LCCE _____ Renovation only: not part of scope
_____ Installation/region issue

2 Commissioning

Goals In Compliance _____ Yes _____ N/A
N/A due to
_____ Mission preclusion _____ Building/site issue
_____ Not LCCE _____ Renovation only: not part of scope
_____ Installation/region issue

(i) Systems commissioned

II. Optimize Energy Performance

3. Energy Efficiency

Goals In Compliance _____ Yes _____ N/A
N/A due to
_____ Mission preclusion _____ Building/site issue
_____ Not LCCE _____ Renovation only: not part of scope
_____ Installation/region issue

(i) Energy Savings Below Baseline %

(ii) Energy Standard

_____ ASHRAE 90.1-2004 (03JAN07-09AUG12)
_____ ASHRAE 90.1-2007 (10AUG12-08JUL14)
_____ ASHRAE 90.1-2010 (09JUL14-05NOV16)
_____ ASHRAE 90.1-2013 (06NOV16+)

_____ IECC
_____ OTHER:

C. Energy Efficient Products

Goals

In Compliance _____ Yes _____ N/A

N/A due to

_____ Mission preclusion

_____ Building/site issue

_____ Not LCCE

_____ Renovation only: not part of scope

_____ Installation/region issue

4. Renewable Energy

Goals

In Compliance _____ Yes _____ N/A

N/A due to

_____ Mission preclusion

_____ Building/site issue

_____ Not LCCE

_____ Renovation only: not part of scope

_____ Installation/region issue

A. Renewable energy technology types

_____ Geothermal

_____ Daylighting (quantified passive)

_____ Ground Source Heat Pumps

_____ Mechanical (i.e., direct water pumping)

_____ Solar Photovoltaic

_____ Micro-hydro

_____ Solar Thermal - domestic hot water

_____ Concentrating (sterling)

_____ Solar Thermal - space conditioning

_____ Wind

(i) Annual % of total load

(ii) System size (kwatts)

B. Solar Hot Water Percentage - 30% target

Goals

In Compliance _____ Yes _____ N/A

N/A due to

_____ Mission preclusion

_____ Building/site issue

_____ Not LCCE

_____ Renovation only: not part of scope

_____ Installation/region issue

(i) Annual % of total load

(ii) System size (kBtu/Year)

5. Metering (Measurement)

Goals

In Compliance _____ Yes _____ N/A

N/A due to

_____ Mission preclusion

_____ Building/site issue

_____ Not LCCE

_____ Renovation only: not part of scope

_____ Installation/region issue

6. Energy Use Intensity kBtu/Sq Ft/Year

(i) Total Design Energy Use Intensity (EUI): kBtu/Sq Ft/Year _____

III. Protect and Conserve Water

7. Indoor Water Use

A. Water-Efficient Products

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

(i) Total Design Indoor Water Use Intensity (WUI): Gallons/Sq Ft/Year

B. Indoor Water Meter

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

8. Outdoor Water Use

A. Outdoor Water Meter

(i) Is there a permanent irrigation system serving more than 25,000 SF of landscaping?

☐ Yes ☐ No

(ii) Water Meter

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

B. Water-efficient landscape

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

C. Reduce landscape potable water use

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

(i) Percent potable water use is reduced

9. Alternative Water Use

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

Methods Proposed:

☐ Air Handler Condensate Capture ☐ Reclaimed Water
☐ Grey Water ☐ Treated Wastewater
☐ Harvested Rainwater ☐ OTHER:

10. Stormwater Management - update the LID Data tab

IV. Enhance Indoor Environmental Quality

11. Ventilation and Thermal Comfort

A. Ventilation

Goals In Compliance _____ Yes _____ N/A
N/A due to
_____ Mission preclusion _____ Building/site issue
_____ Not LCCE _____ Renovation only: not part of scope
_____ Installation/region issue _____

B. Thermal Comfort

Goals In Compliance _____ Yes _____ N/A
N/A due to
_____ Mission preclusion _____ Building/site issue
_____ Not LCCE _____ Renovation only: not part of scope
_____ Installation/region issue _____

12. Daylighting and Lighting Controls

A. Daylight

Goals In Compliance _____ Yes _____ N/A
N/A due to
_____ Mission preclusion _____ Building/site issue
_____ Not LCCE _____ Renovation only: not part of scope
_____ Installation/region issue _____

B. Automatic dimming controls

Goals In Compliance _____ Yes _____ N/A
N/A due to
_____ Mission preclusion _____ Building/site issue
_____ Not LCCE _____ Renovation only: not part of scope
_____ Installation/region issue _____

13. Indoor Air Quality

A. Moisture Control

Goals In Compliance _____ Yes _____ N/A
N/A due to
_____ Mission preclusion _____ Building/site issue
_____ Not LCCE _____ Renovation only: not part of scope
_____ Installation/region issue _____

B. Low-Emitting Materials

Goals In Compliance _____ Yes _____ N/A
N/A due to
_____ Mission preclusion _____ Building/site issue
_____ Not LCCE _____ Renovation only: not part of scope
_____ Installation/region issue _____

C. Indoor Air Quality during Construction

Goals In Compliance _____ Yes _____ N/A
N/A due to
_____ Mission preclusion _____ Building/site issue
_____ Not LCCE _____ Renovation only: not part of scope
_____ Installation/region issue _____

14. Occupant Health and Wellness

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

V. Reduce the Environmental Impact of Materials

15. Material Content and Performance

A. Resource Conservation and Recovery Act (RCRA) Section 6002 (recycled content)

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

B. Farm Security and Rural Investment Act (FSRIA) section 9002 (Biobased content)

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

C. Ozone depleting Compounds

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

16. Waste Management

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

17. Waste Diversion - 60% target

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

(i) Percent diverted _____

VI. Assess and Consider Climate Change Risks

18. Address Climate Change Risk

Goals In Compliance ☐ Yes ☐ N/A
N/A due to
☐ Mission preclusion ☐ Building/site issue
☐ Not LCCE ☐ Renovation only: not part of scope
☐ Installation/region issue

THIRD PARTY CERTIFICATION INFORMATION

Does at least one building meet one of the following: _____ Yes _____ No

1) New construction with construction cost greater than \$3M? - **OR** -

2) In an existing building larger than 5,000 SF, renovation with construction cost greater than \$3M and 50% estimated replacement cost (ERC)?

Sustainability Third Party Certification Rating

Third Party Certification Rating System and Level

_____ USGBC LEED Certified

_____ USGBC LEED Silver

_____ USGBC LEED Gold

_____ USGBC LEED Platinum

_____ USGBC "Guiding Principles Assessment"

_____ OTHER

_____ GBI Green Globes 1 Globe

_____ GBI Green Globes 2 Globe

_____ GBI Green Globes 3 Globe

_____ GBI Green Globes 4 Globe

_____ GBI "Guiding Principles Compliance"

i. Third Party Certification Rating system - Other

--



LEED v4 for BD+C: New Construction and Major Renovation Project Checklist

Project Name: NOAA OMAO Ship & Support Facility Relocation
Revision/Date: Final Design Submittal 7/2022

Y ? N

0 0 1

Credit Integrative Process

1

2	0	30	Location and Transportation	32
0	0	16	Credit LEED for Neighborhood Development Location	16
1	0	0	Credit Sensitive Land Protection	1
0	0	2	Credit High Priority Site	2
0	0	5	Credit Surrounding Density and Diverse Uses	5
0	0	5	Credit Access to Quality Transit	5
0	0	1	Credit Bicycle Facilities	1
0	0	1	Credit Reduced Parking Footprint	1
1	0	0	Credit Green Vehicles	1

5	0	5	Sustainable Sites	10
Y			Prereq Construction Activity Pollution Prevention	Required
1	0	0	Credit Site Assessment	1
1	0	1	Credit Site Development - Protect or Restore Habitat	2
0	0	1	Credit Open Space	1
0	0	3	Credit Rainwater Management	3
2	0	0	Credit Heat Island Reduction	2
1	0	0	Credit Light Pollution Reduction	1

6	0	5	Water Efficiency	11
Y			Prereq Outdoor Water Use Reduction	Required
Y			Prereq Indoor Water Use Reduction	Required
Y			Prereq Building-Level Water Metering	Required
2	0	0	Credit Outdoor Water Use Reduction	2
3	0	3	Credit Indoor Water Use Reduction	6
0	0	2	Credit Cooling Tower Water Use	2
1	0	0	Credit Water Metering	1

20	0	16	Energy and Atmosphere	33
Y			Prereq Fundamental Commissioning and Verification	Required
Y			Prereq Minimum Energy Performance	Required
Y			Prereq Building-Level Energy Metering	Required
Y			Prereq Fundamental Refrigerant Management	Required
3	0	3	Credit Enhanced Commissioning	6
12	0	6	Credit Optimize Energy Performance	18
0	0	1	Credit Advanced Energy Metering	1
0	0	2	Credit Demand Response	2
0	0	3	Credit Renewable Energy Production	3
0	0	1	Credit Enhanced Refrigerant Management	1
5	0	0	Credit Green Power and Carbon Offsets	2

6	0	7	Materials and Resources	13
Y			Prereq Storage and Collection of Recyclables	Required
Y			Prereq Construction and Demolition Waste Management Planning	Required
1	0	4	Credit Building Life-Cycle Impact Reduction	5
1	0	1	Credit Building Product Disclosure and Optimization - Environmental Product Declarations	2
1	0	1	Credit Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
1	0	1	Credit Building Product Disclosure and Optimization - Material Ingredients	2
2	0	0	Credit Construction and Demolition Waste Management	2

11	0	5	Indoor Environmental Quality	16
Y			Prereq Minimum Indoor Air Quality Performance	Required
Y			Prereq Environmental Tobacco Smoke Control	Required
2	0	0	Credit Enhanced Indoor Air Quality Strategies	2
3	0	0	Credit Low-Emitting Materials	3
1	0	0	Credit Construction Indoor Air Quality Management Plan	1
2	0	0	Credit Indoor Air Quality Assessment	2
1	0	0	Credit Thermal Comfort	1
2	0	0	Credit Interior Lighting	2
0	0	3	Credit Daylight	3
0	0	1	Credit Quality Views	1
0	0	1	Credit Acoustic Performance	1

6	0	0	Innovation	6
1	0	0	Credit Exemplary Performance - IEQ Low Emitting Materials	1
1	0	0	Credit Exemplary Performance - M&R Environmental Product Declarations	1
1	0	0	Credit Innovation - Lamp Purchasing	1
1	0	0	Credit Innovation - O&M Starter, Green Cleaning Policy	1
1	0	0	Credit Pilot Credit - Legal Wood	1
1	0	0	Credit LEED Accredited Professional	1

1	0	5	Regional Priority	6
0	0	1	Credit Regional Priority: : Rainwater Management	1
1	0	0	Credit Regional Priority: : Optimize Energy	1
0	0	1	Credit Regional Priority: : Access to Quality Transit	1
0	0	1	Credit Regional Priority: : Building Life-Cycle Impact	1
0	0	1	Credit Regional Priority: : High Priority Site	1
0	0	1	Credit Regional Priority: : Bicycle Facilities	1

57 0 73 TOTALS Possible Points: **128**

Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110

SECTION 01 35 13

SPECIAL PROJECT PROCEDURES

11/20

PART 1 GENERAL

1.1 DEFINITIONS

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Watercraft List

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 HARBOR WATERWAYS

In addition to DFARS 252.236-7002 Obstruction of Navigable Waterways, obtain from the NAVSTA Newport Contracting Officer, permission to use Coddington Cove within Narragansett Bay waterways and the regulations and directives governing such usage. Submit a watercraft list with a description of crafts, including sizes, types, numbers and boat crew for approval.

3.1.1 Hazards to Navigation

Maintain complete control of the movement of floating equipment and material. Loose floating equipment and material are not permitted. Keep in readiness at all times a powered craft capable of moving, securing and disposing of floating equipment which may get loose and become a hazard to navigation.

3.1.2 Submarine Cables or Underwater Utilities

Physically locate submarine cables or underwater utilities as indicated prior to performance of work.

-- End of Section --

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SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS
11/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B30.3	(2020) Tower Cranes
ASME B30.5	(2018) Mobile and Locomotive Cranes
ASME B30.7	(2016) Winches
ASME B30.8	(2015) Floating Cranes and Floating Derricks
ASME B30.9	(2018) Slings
ASME B30.20	(2018) Below-the-Hook Lifting Devices
ASME B30.22	(2016) Articulating Boom Cranes
ASME B30.23	(2016) Personnel Lifting Systems Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings
ASME B30.26	(2015; R 2020) Rigging Hardware

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.22	(2007; R 2017) Safety Requirements for Rope-Guided and Non-Guided Workers' Hoists
ASSP A10.34	(2001; R 2012) Protection of the Public on or Adjacent to Construction Sites
ASSP A10.44	(2020) Control of Energy Sources (Lockout/Tagout) for Construction and Demolition Operations
ASSP Z244.1	(2016) The Control of Hazardous Energy Lockout, Tagout and Alternative Methods
ASSP Z359.0	(2018) Definitions and Nomenclature Used for Fall Protection and Fall Arrest
ASSP Z359.1	(2016) The Fall Protection Code
ASSP Z359.2	(2017) Minimum Requirements for a Comprehensive Managed Fall Protection

Program

ASSP Z359.3	(2019) Safety Requirements for Lanyards and Positioning Lanyards
ASSP Z359.4	(2013) Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components
ASSP Z359.6	(2016) Specifications and Design Requirements for Active Fall Protection Systems
ASSP Z359.7	(2019) Qualification and Verification Testing of Fall Protection Products
ASSP Z359.11	(2014) Safety Requirements for Full Body Harnesses
ASSP Z359.12	(2019) Connecting Components for Personal Fall Arrest Systems
ASSP Z359.13	(2013) Personal Energy Absorbers and Energy Absorbing Lanyards
ASSP Z359.14	(2014) Safety Requirements for Self-Retracting Devices for Personal Fall Arrest and Rescue Systems
ASSP Z359.15	(2014) Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest Systems
ASSP Z359.16	(2016) Safety Requirements for Climbing Ladder Fall Arrest Systems
ASSP Z359.18	(2017) Safety Requirements for Anchorage Connectors for Active Fall Protection Systems

ASTM INTERNATIONAL (ASTM)

ASTM F855	(2019) Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1048	(2016) Guide for Protective Grounding of Power Lines
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA Z535.2	(2011; R 2017) Environmental and Facility Safety Signs
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2018; ERTA 1-2 2018) Standard for Portable Fire Extinguishers
NFPA 51B	(2019) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 70E	(2021) Standard for Electrical Safety in the Workplace
NFPA 241	(2019) Standard for Safeguarding Construction, Alteration, and Demolition Operations
NFPA 306	(2019) Standard for the Control of Gas Hazards on Vessels

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-222	(2018H; Add 1 2019) Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures
TIA-1019	(2012; R 2016) Standard for Installation, Alteration and Maintenance of Antenna Supporting Structures and Antennas

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 20	Standards for Protection Against Radiation
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1910.147	The Control of Hazardous Energy (Lock Out/Tag Out)
29 CFR 1910.333	Selection and Use of Work Practices
29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1915.89	Control of Hazardous Energy (Lockout/Tags-Plus)

29 CFR 1919	Gear Certification
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.16	Rules of Construction
29 CFR 1926.450	Scaffolds
29 CFR 1926.500	Fall Protection
29 CFR 1926.552	Material Hoists, Personal Hoists, and Elevators
29 CFR 1926.553	Base-Mounted Drum Hoists
29 CFR 1926.1400	Cranes and Derricks in Construction
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
CPL 02-01-056	(2014) Inspection Procedures for Accessing Communication Towers by Hoist
CPL 2.100	(1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146

1.2 DEFINITIONS

1.2.1 Competent Person (CP)

The CP is a person designated in writing, who, through training, knowledge and experience, is capable of identifying, evaluating, and addressing existing and predictable hazards in the working environment or working conditions that are dangerous to personnel, and who has authorization to take prompt corrective measures with regards to such hazards.

1.2.2 Competent Person, Confined Space

The CP, Confined Space, is a person meeting the competent person requirements as defined EM 385-1-1 Appendix Q, with thorough knowledge of OSHA's Confined Space Standard, 29 CFR 1910.146, and designated in writing to be responsible for the immediate supervision, implementation and monitoring of the confined space program, who through training, knowledge and experience in confined space entry is capable of identifying, evaluating and addressing existing and potential confined space hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.3 Competent Person, Cranes and Rigging

The CP, Cranes and Rigging, as defined in EM 385-1-1 Appendix Q, is a person meeting the competent person, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the Crane and Rigging Program, who through training, knowledge and experience in crane and rigging is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.4 Competent Person, Excavation/Trenching

A CP, Excavation/Trenching, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and 29 CFR 1926, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the excavation/trenching program, who through training, knowledge and experience in excavation/trenching is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.5 Competent Person, Fall Protection

The CP, Fall Protection, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and in accordance with ASSP Z359.0, who has been designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the fall protection program, who through training, knowledge and experience in fall protection and rescue systems and equipment, is capable of identifying, evaluating and addressing existing and potential fall hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.6 Competent Person, Scaffolding

The CP, Scaffolding is a person meeting the competent person requirements in EM 385-1-1 Appendix Q, and designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the scaffolding program. The CP for Scaffolding has enough training, knowledge and experience in scaffolding to correctly identify, evaluate and address existing and potential hazards and also has the authority to take prompt corrective measures with regard to these hazards. CP qualifications must be documented including experience on the specific scaffolding systems/types being used, assessment of the base material that the scaffold will be erected upon, load calculations for materials and personnel, and erection and dismantling. The CP for scaffolding must have a documented minimum of 8-hours of scaffold training to include training on the specific type of scaffold being used (e.g. mast-climbing, adjustable, tubular frame), in accordance with EM 385-1-1 Section 22.B.02.

1.2.7 Competent Person (CP) Trainer

A competent person trainer as defined in EM 385-1-1 Appendix Q, who is qualified in the training material presented, and who possesses a working knowledge of applicable technical regulations, standards, equipment and systems related to the subject matter on which they are training Competent Persons. A competent person trainer must be familiar with the typical hazards and the equipment used in the industry they are instructing. The training provided by the competent person trainer must be appropriate to that specific industry. The competent person trainer must evaluate the knowledge and skills of the competent persons as part of the training process.

1.2.8 High Risk Activities

High Risk Activities are activities that involve work at heights, crane and rigging, excavations and trenching, scaffolding, electrical work, and confined space entry.

1.2.9 High Visibility Accident

A High Visibility Accident is any mishap which may generate publicity or high visibility.

1.2.10 Load Handling Equipment (LHE)

LHE is a term used to describe cranes, hoists and all other hoisting equipment (hoisting equipment means equipment, including crane, derricks, hoists and power operated equipment used with rigging to raise, lower or horizontally move a load).

1.2.11 Medical Treatment

Medical Treatment is treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even when provided by a physician or registered personnel.

1.2.12 Near Miss

A Near Miss is a mishap resulting in no personal injury and zero property damage, but given a shift in time or position, damage or injury may have occurred (e.g., a worker falls off a scaffold and is not injured; a crane swings around to move the load and narrowly misses a parked vehicle).

1.2.13 Operating Envelope

The Operating Envelope is the area surrounding any crane or load handling equipment. Inside this "envelope" is the crane, the operator, riggers and crane walkers, other personnel involved in the operation, rigging gear between the hook, the load, the crane's supporting structure (i.e. ground or rail), the load's rigging path, the lift and rigging procedure.

1.2.14 Qualified Person (QP)

The QP is a person designated in writing, who, by possession of a recognized degree, certificate, or professional standing, or extensive knowledge, training, and experience, has successfully demonstrated their ability to solve or resolve problems related to the subject matter, the work, or the project.

1.2.15 Qualified Person, Fall Protection (QP for FP)

A QP for FP is a person meeting the definition requirements of EM 385-1-1 Appendix Q, and ASSP Z359.2 standard, having a recognized degree or professional certificate and with extensive knowledge, training and experience in the fall protection and rescue field who is capable of designing, analyzing, and evaluating and specifying fall protection and rescue systems.

1.2.16 Recordable Injuries or Illnesses

Recordable Injuries or Illnesses are any work-related injury or illness that results in:

- a. Death, regardless of the time between the injury and death, or the length of the illness;

- b. Days away from work (any time lost after day of injury/illness onset);
- c. Restricted work;
- d. Transfer to another job;
- e. Medical treatment beyond first aid;
- f. Loss of consciousness; or
- g. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (a) through (f) above

1.2.17 Government Property and Equipment

Interpret "USACE" property and equipment specified in USACE EM 385-1-1 as Government property and equipment.

1.2.18 Load Handling Equipment (LHE) Accident or Load Handling Equipment Mishap

A LHE accident occurs when any one or more of the eight elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; or collision, including unplanned contact between the load, crane, or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents, even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, or roll over). Document an LHE mishap or accident using the NAVFAC prescribed Navy Crane Center (NCC) accident form.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G

APP - Construction; G

Dive Operations Plan; G

SD-06 Test Reports

Monthly Exposure Reports

Notifications and Reports

Accident Reports; G

LHE Inspection Reports

SD-07 Certificates

Contractor Safety Self-Evaluation Checklist

Crane Operators/Riggers

Standard Lift Plan; G

Critical Lift Plan ; G

Naval Architecture Analysis; G

Activity Hazard Analysis (AHA)

Confined Space Entry Permit

Hot Work Permit

Certificate of Compliance

Third Party Certification of Floating Cranes and Barge-Mounted
Mobile Cranes

License Certificates

Radiography Operation Planning Work Sheet; G

Portable Gauge Operations Planning Worksheet; G

1.4 MONTHLY EXPOSURE REPORTS

Provide a Monthly Exposure Report and attach to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both Prime and subcontractor. Failure to submit the report may result in retention of up to 10 percent of the voucher.

1.5 CONTRACTOR SAFETY SELF-EVALUATION CHECKLIST

Contracting Officer will provide a "Contractor Safety Self-Evaluation checklist" to the Contractor at the pre-construction meeting. Complete the checklist monthly and submit with each request for payment voucher. An acceptable score of 90 or greater is required. Failure to submit the completed safety self-evaluation checklist or achieve a score of at least 90 may result in retention of up to 10 percent of the voucher. The Contractor Safety Self-Evaluation checklist can be found on the Whole Building Design Guide website at www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-01-35-26

1.6 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this Contract, comply with the most recent edition of USACE EM 385-1-1, and the following federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws,

criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.6.1 Subcontractor Safety Requirements

For this Contract, neither Contractor nor any subcontractor may enter into Contract with any subcontractor that fails to meet the following requirements. The term subcontractor in this and the following paragraphs means any entity holding a Contract with the Contractor or with a subcontractor at any tier.

1.6.1.1 Experience Modification Rate (EMR)

Subcontractors on this Contract must have an effective EMR less than or equal to 1.10, as computed by the National Council on Compensation Insurance (NCCI) or if not available, as computed by the state agency's rating bureau in the state where the subcontractor is registered, when entering into a subcontract agreement with the Prime Contractor or a subcontractor at any tier. The Prime Contractor may submit a written request for additional consideration to the Contracting Officer where the specified acceptable EMR range cannot be achieved. Relaxation of the EMR range will only be considered for approval on a case-by-case basis for special conditions and must not be anticipated as tacit approval. Contractor's Site Safety and Health Officer (SSHO) must collect and maintain the certified EMR ratings for all subcontractors on the project and make them available to the Government at the Government's request.

1.6.1.2 OSHA Days Away from Work, Restricted Duty, or Job Transfer (DART) Rate

Subcontractors on this Contract must have a DART rate, calculated from the most recent, complete calendar year, less than or equal to 3.4 when entering into a subcontract agreement with the Prime Contractor or a subcontractor at any tier. The OSHA Dart Rate is calculated using the following formula:

$$(N/EH) \times 200,000$$

where:

N = number of injuries and illnesses with days away, restricted work, or job transfer

EH = total hours worked by all employees during most recent, complete calendar year

200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year)

The Prime Contractor may submit a written request for additional consideration to the Contracting Officer where the specified acceptable OSHA Dart rate range cannot be achieved for a particular subcontractor. Relaxation of the OSHA DART rate range will only be considered for approval on a case-by-case basis for special conditions and must not be anticipated as tacit approval. Contractor's Site Safety and Health Officer (SSHO) must collect and maintain self-certified OSHA DART rates for all subcontractors on the project and make them available to the Government at the Government's request.

1.7 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

1.7.1 Personnel Qualifications

1.7.1.1 Site Safety and Health Officer (SSHO)

Provide an SSHO that meets the requirements of EM 385-1-1 Section 1. The SSHO must ensure that the requirements of 29 CFR 1926.16 are met for the project. Provide a Safety oversight team that includes a minimum of one person at each project site to function as the Site Safety and Health Officer (SSHO). The SSHO or an equally-qualified Alternate SSHO must be at the work site at all times to implement and administer the Contractor's safety program and Government-accepted Accident Prevention Plan. The SSHO and Alternate SSHO must have the required training, experience, and qualifications in accordance with EM 385-1-1 Section 01.A.17, and all associated sub-paragraphs.

If the SSHO is off-site for a period longer than 24 hours, an equally-qualified alternate SSHO must be provided and must fulfill the same roles and responsibilities as the primary SSHO. When the SSHO is temporarily (up to 24 hours) off-site, a Designated Representative (DR), as identified in the AHA may be used in lieu of an Alternate SSHO, and must be on the project site at all times when work is being performed. Note that the DR is a collateral duty safety position, with safety duties in addition to their full time occupation.

1.7.1.1.1 Additional Site Safety and Health Officer (SSHO) Requirements and Duties

The SSHO may not serve as the Quality Control Manager. The SSHO may not serve as the Superintendent.

1.7.1.2 Competent Person Qualifications

Provide Competent Persons in accordance with EM 385-1-1, Appendix Q and herein. Competent Persons for high risk activities include confined space, cranes and rigging, excavation/trenching, fall protection, and electrical work. The CP for these activities must be designated in writing, and meet the requirements for the specific activity (i.e. competent person, fall protection).

The Competent Person identified in the Contractor's Safety and Health Program and accepted Accident Prevention Plan, must be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Provide the credentials of the Competent Persons(s) to the Contracting Officer for information in consultation with the Safety Office.

1.7.1.2.1 Competent Person for Confined Space Entry

Provide a Confined Space (CP) Competent Person who meets the requirements of EM 385-1-1, Appendix Q, and herein. The CP for Confined Space Entry must supervise the entry into each confined space in accordance with EM 385-1-1, Section 34.

Since this work involves operations that handle combustible or hazardous materials, this person must have the ability to understand and follow through on the air sampling, Personal Protective Equipment (PPE), and instructions of a Marine Chemist, Coast Guard authorized persons, or

Certified Industrial Hygienist. Confined space and enclosed space work must comply with NFPA 306, OSHA 29 CFR 1915, Subpart B, "Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment," or as applicable, 29 CFR 1910.147 for general industry.

1.7.1.2.2 Competent Person for Scaffolding

Provide a Competent Person for Scaffolding who meets the requirements of EM 385-1-1, Section 22.B.02 and herein.

1.7.1.2.3 Competent Person for Fall Protection

Provide a Competent Person for Fall Protection who meets the requirements of EM 385-1-1, Section 21.C.04, 21.B.03, and herein.

1.7.1.3 Qualified Trainer Requirements

Individuals qualified to instruct the 40 hour contract safety awareness course, or portions thereof, must meet the definition of a Competent Person Trainer, and, at a minimum, possess a working knowledge of the following subject areas: EM 385-1-1, Electrical Standards, Lockout/Tagout, Fall Protection, Confined Space Entry for Construction; Excavation, Trenching and Soil Mechanics, and Scaffolds in accordance with 29 CFR 1926.450, Subpart L.

Instructors are required to:

- a. Prepare class presentations that cover construction-related safety requirements.
- b. Ensure that all attendees attend all sessions by using a class roster signed daily by each attendee. Maintain copies of the roster for at least five years. This is a certification class and must be attended 100 percent. In cases of emergency where an attendee cannot make it to a session, the attendee can make it up in another class session for the same subject.
- c. Update training course materials whenever an update of the EM 385-1-1 becomes available.
- d. Provide a written exam of at least 50 questions. Students are required to answer 80 percent correctly to pass.
- e. Request, review and incorporate student feedback into a continuous course improvement program.

1.7.1.4 Dredging Contract Requirements

1.7.1.5 Crane Operators/Riggers

Provide Operators, Signal Persons, and Riggers meeting the requirements in EM 385-1-1, Section 15.B for Riggers and Section 16.B for Crane Operators and Signal Persons. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacities of 50,000 pounds or greater, designate crane operators qualified by a source that qualifies crane operators (i.e., union, a Government agency, or an organization that tests and qualifies crane operators). Provide proof of current qualification.

1.7.2 Personnel Duties

1.7.2.1 Duties of the Site Safety and Health Officer (SSHO)

The SSHO must:

- a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily production report.
- b. Conduct mishap investigations and complete required accident reports. Report mishaps and near misses.
- c. Use and maintain OSHA's Form 300 to log work-related injuries and illnesses occurring on the project site for Prime Contractors and subcontractors, and make available to the Contracting Officer upon request. Post and maintain the Form 300A on the site Safety Bulletin Board.
- d. Maintain applicable safety reference material on the job site.
- e. Attend the pre-construction meeting conference, pre-work meetings including preparatory meetings, and periodic in-progress meetings.
- f. Review the APP and AHAs for compliance with EM 385-1-1, and approve, sign, implement and enforce them.
- g. Establish a Safety and Occupational Health (SOH) Deficiency Tracking System that lists and monitors outstanding deficiencies until resolution.
- h. Ensure subcontractor compliance with safety and health requirements.
- i. Maintain a list of hazardous chemicals on site and their material Safety Data Sheets (SDS).
- j. Maintain a weekly list of high hazard activities involving energy, equipment, excavation, entry into confined space, and elevation, and be prepared to discuss details during QC Meetings.
- k. Provide and keep a record of site safety orientation and indoctrination for Contractor employees, subcontractor employees, and site visitors.

Superintendent, QC Manager, and SSHO are subject to dismissal if the above or any other required duties are not being effectively carried out. If either the Superintendent, QC Manager, or SSHO are dismissed, project work will be stopped and will not be allowed to resume until a suitable replacement is approved and the above duties are again being effectively carried out.

1.7.3 Meetings

1.7.3.1 Preconstruction Meeting

- a. Contractor representatives who have a responsibility or significant role in accident prevention on the project must attend the

preconstruction meeting. This includes the project superintendent, Site Safety and Occupational Health Officer, quality control manager, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

- b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the Contract. This list of proposed AHAs will be reviewed and an agreement will be reached between the Contractor and the Contracting Officer as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, and Government review of AHAs to preclude project delays.
- c. Deficiencies in the submitted APP, identified during the Contracting Officer's review, must be corrected, and the APP re-submitted for review prior to the start of construction. Work is not permitted to begin until an APP is established that is acceptable to the Contracting Officer.

1.7.3.2 Safety Meetings

Conduct safety meetings to review past activities, plan for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide pertinent Safety and Occupational Health (SOH) training and motivation. Conduct meetings at least once a month for all supervisors at the project location. The SSHO, supervisors, foremen, or CDSOs must conduct meetings at least once a week for the trade workers. Document meeting minutes to include the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Maintain documentation on-site and furnish copies to the Contracting Officer on request. Notify the Contracting Officer of all scheduled meetings 7 calendar days in advance.

1.8 ACCIDENT PREVENTION PLAN (APP)

1.8.1 APP - Construction

A qualified person must prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of EM 385-1-1, Appendix A, and as supplemented herein. Cover all paragraph and subparagraph elements in EM 385-1-1, Appendix A. The APP must be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP must interface with the Contractor's overall safety and health program referenced in the APP in the applicable APP element, and made site-specific. Describe the methods to evaluate past safety performance of potential subcontractors in the selection process. Also, describe innovative methods used to ensure and monitor safe work practices of subcontractors. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the Contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP must be signed by an officer of the firm (Prime Contractor senior person), the individual preparing the APP, the on-site superintendent, the

designated SSHO, the Contractor Quality Control Manager, and any designated Certified Safety Professional (CSP) or Certified Health Physicist (CIH). The SSHO must provide and maintain the APP and a log of signatures by each subcontractor foreman, attesting that they have read and understand the APP, and make the APP and log available on-site to the Contracting Officer. If English is not the foreman's primary language, the Prime Contractor must provide an interpreter.

Submit the APP to the Contracting Officer 15 calendar days prior to the date of the preconstruction meeting for acceptance. Work cannot proceed without an accepted APP. Once reviewed and accepted by the Contracting Officer, the APP and attachments will be enforced as part of the Contract. Disregarding the provisions of this Contract or the accepted APP is cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified. Continuously review and amend the APP, as necessary, throughout the life of the Contract. Changes to the accepted APP must be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and Quality Control Manager. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered. Should any severe hazard exposure (i.e. imminent danger) become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate and remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSP A10.34), and the environment.

1.8.2 Names and Qualifications

Provide plans in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

- a. Names and qualifications (resumes including education, training, experience and certifications) of site safety and health personnel designated to perform work on this project to include the designated Site Safety and Health Officer and other competent and qualified personnel to be used. Specify the duties of each position.
- b. Qualifications of competent and of qualified persons. As a minimum, designate and submit qualifications of competent persons for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; and personal protective equipment and clothing to include selection, use and maintenance.

1.8.3 Plans

Provide plans in the APP in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

1.8.3.1 Confined Space Entry Plan

Develop a confined or enclosed space entry plan in accordance with EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive CPL 2.100, and any other federal, state and local regulatory requirements identified in this Contract. Identify the qualified person's name and qualifications, training, and experience.

Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by Contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

1.8.3.2 Standard Lift Plan (SLP)

Plan lifts to avoid situations where the operator cannot maintain safe control of the lift. Prepare a written SLP in accordance with EM 385-1-1, Section 16.A.03, using Form 16-2 for every lift or series of lifts (if duty cycle or routine lifts are being performed). The SLP must be developed, reviewed and accepted by all personnel involved in the lift in conjunction with the associated AHA. Signature on the AHA constitutes acceptance of the plan. Maintain the SLP on the LHE for the current lift(s) being made. Maintain historical SLPs for a minimum of three months.

1.8.3.3 Critical Lift Plan - Crane or Load Handling Equipment

Provide a Critical Lift Plan as required by EM 385-1-1, Section 16.H.01, using Form 16-3. In addition, Critical Lift Plans are required for the following:

- a. Lifts over 50 percent of the capacity of barge mounted mobile crane's hoist.
- b. When working around energized power lines where the work will get closer than the minimum clearance distance in EM 385-1-1 Table 16-1.
- c. For lifts with anticipated binding conditions.
- d. When erecting cranes.

1.8.3.3.1 Critical Lift Plan Planning and Schedule

Critical lifts require detailed planning and additional or unusual safety precautions. Develop and submit a critical lift plan to the Contracting Officer 30 calendar days prior to critical lift. Comply with load testing requirements in accordance with EM 385-1-1, Section 16.F.03.

1.8.3.3.2 Lifts of Personnel

In addition to the requirements of EM 385-1-1, Section 16.H.02, for lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.1400 and EM 385-1-1, Section 16.T.

1.8.3.4 Barge Mounted Mobile Crane Lift Plan

Provide a Naval Architecture Analysis and include an LHE Manufacturer's Floating Service Load Chart in accordance with EM 385-1-1, Section 16.L.03.

1.8.3.5 Multi-Purpose Machines, Material Handling Equipment, and Construction Equipment Lift Plan

Multi-purpose machines, material handling equipment, and construction equipment used to lift loads that are suspended by rigging gear, require proof of authorization from the machine OEM that the machine is capable of making lifts of loads suspended by rigging equipment. Written approval

from a qualified registered professional engineer, after a safety analysis is performed, is allowed in lieu of the OEM's approval. Demonstrate that the operator is properly trained and that the equipment is properly configured to make such lifts and is equipped with a load chart.

1.8.3.6 Fall Protection and Prevention (FP&P) Plan

The plan must be in accordance with the requirements of EM 385-1-1, Section 21.D and ASSP Z359.2, be site specific, and address all fall hazards in the work place and during different phases of construction. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet. A competent person or qualified person for fall protection must prepare and sign the plan documentation. Include fall protection and prevention systems, equipment and methods employed for every phase of work, roles and responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Review and revise, as necessary, the Fall Protection and Prevention Plan documentation as conditions change, but at a minimum every six months, for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. Keep and maintain the accepted Fall Protection and Prevention Plan documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Plan documentation in the Accident Prevention Plan (APP).

1.8.3.7 Rescue and Evacuation Plan

Provide a Rescue and Evacuation Plan in accordance with EM 385-1-1 Section 21.N and ASSP Z359.2, and include in the FP&P Plan and as part of the APP. Include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility.

1.8.3.8 Hazardous Energy Control Program (HECP)

Develop a HECP in accordance with EM 385-1-1 Section 12, 29 CFR 1910.147, 29 CFR 1910.333, 29 CFR 1915.89, ASSP Z244.1, and ASSP A10.44. Submit this HECP as part of the Accident Prevention Plan (APP). Conduct a preparatory meeting and inspection with all effected personnel to coordinate all HECP activities. Document this meeting and inspection in accordance with EM 385-1-1, Section 12.A.02. Ensure that each employee is familiar with and complies with these procedures.

1.8.3.9 Excavation Plan

Identify the safety and health aspects of excavation, and provide and prepare the plan in accordance with EM 385-1-1, Section 25.A and Section 31 23 00.00 20 Excavation and Fill.

1.8.3.10 Site Safety and Health Plan

Identify the safety and health aspects, and prepare in accordance with Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES.

1.8.3.11 Site Demolition Plan

Identify the safety and health aspects, and prepare in accordance with

Section 02 41 00 DEMOLITION and referenced sources. Include engineering survey as applicable.

1.9 ACTIVITY HAZARD ANALYSIS (AHA)

Before beginning each activity, task or Definable Feature of Work (DFOW) involving a type of work presenting hazards not experienced in previous project operations, or where a new work crew or subcontractor is to perform the work, the Contractor(s) performing that work activity must prepare an AHA. AHAs must be developed by the Prime Contractor, subcontractor, or supplier performing the work, and provided for Prime Contractor review and approval before submitting to the Contracting Officer. AHAs must be signed by the SSHO, Superintendent, QC Manager and the subcontractor Foreman performing the work. Format the AHA in accordance with EM 385-1-1, Section 1 or as directed by the Contracting Officer. Submit the AHA for review at least 15 working days prior to the start of each activity task, or DFOW. The Government reserves the right to require the Contractor to revise and resubmit the AHA if it fails to effectively identify the work sequences, specific anticipated hazards, site conditions, equipment, materials, personnel and the control measures to be implemented.

AHAs must identify competent persons required for phases involving high risk activities, including confined entry, crane and rigging, excavations, trenching, electrical work, fall protection, and scaffolding.

1.9.1 AHA Management

Review the AHA list periodically (at least monthly) at the Contractor supervisory safety meeting, and update as necessary when procedures, scheduling, or hazards change. Use the AHA during daily inspections by the SSHO to ensure the implementation and effectiveness of the required safety and health controls for that work activity.

1.9.2 AHA Signature Log

Each employee performing work as part of an activity, task or DFOW must review the AHA for that work and sign a signature log specifically maintained for that AHA prior to starting work on that activity. The SSHO must maintain a signature log on site for every AHA. Provide employees whose primary language is other than English, with an interpreter to ensure a clear understanding of the AHA and its contents.

1.10 DISPLAY OF SAFETY INFORMATION

1.10.1 Safety Bulletin Board

Prior to commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the Contracting Officer, that is accessible and includes all mandatory information for employee and visitor review, may be deemed as meeting the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by EM 385-1-1, Section 01.A.07. Additional items required to be posted include:

- a. Confined space entry permit.
- b. Hot work permit.

1.10.2 Safety and Occupational Health (SOH) Deficiency Tracking System

Establish a SOH deficiency tracking system that lists and monitors the status of SOH deficiencies in chronological order. Use the tracking system to evaluate the effectiveness of the APP. A monthly evaluation of the data must be discussed in the QC or SOH meeting with everyone on the project. The list must be posted on the project bulletin board and updated daily, and provide the following information:

- a. Date deficiency identified;
- b. Description of deficiency;
- c. Name of person responsible for correcting deficiency;
- d. Projected resolution date;
- e. Date actually resolved.

1.11 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in paragraph REFERENCES. Maintain applicable equipment manufacturer's manuals.

1.12 EMERGENCY MEDICAL TREATMENT

Contractors must arrange for their own emergency medical treatment in accordance with EM 385-1-1. Government has no responsibility to provide emergency medical treatment.

1.13 NOTIFICATIONS and REPORTS

1.13.1 Mishap Notification

Notify the Contracting Officer as soon as practical, but no more than twenty-four hours, after any mishaps, including recordable accidents, incidents, and near misses, as defined in EM 385-1-1 Appendix Q, any report of injury, illness, or any property damage. For LHE or rigging mishaps, notify the Contracting Officer as soon as practical but not more than four hours after mishap. The Contractor is responsible for obtaining appropriate medical and emergency assistance and for notifying fire, law enforcement, and regulatory agencies. Immediate reporting is required for electrical mishaps, to include Arc Flash; shock; uncontrolled release of hazardous energy (includes electrical and non-electrical); load handling equipment or rigging; fall from height (any level other than same surface); and underwater diving. These mishaps must be investigated in depth to identify all causes and to recommend hazard control measures.

Within notification include Contractor name; Contract title; type of Contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (for example, type of construction equipment used and PPE used). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted. Assist and cooperate fully with the Government's investigation(s) of any mishap.

1.13.2 Accident Reports

- a. Conduct an accident investigation for recordable injuries and illnesses, property damage, and near misses as defined in EM 385-1-1, to establish the root cause(s) of the accident. Complete the applicable NAVFAC Contractor Incident Reporting System (CIRS), and electronically submit via the NAVFAC Enterprise Safety Applications Management System (ESAMS). Complete and submit an accident investigation report in ESAMS within 5 days for mishaps defined in EM 385-1-1 01.D.03 and 10 days for accidents defined by EM 385-1-1 01.D.05. Complete an investigation report within 30 days for those mishaps defined by EM 385-1-1 01.D.04. Mishaps defined by EM 385-1-1 01.D.04 and 01.D.05 must include a written report submitted as an attachment in ESAMS using the following outline: (1) Mishap summary description to include process, findings and outcomes; (2) Root Cause; (3) Direct Factors; (4) Indirect and Contributing Factors; (5) Corrective Actions; and (6) Recommendations. The Contracting Officer will provide copies of any required or special forms.
- b. Near Misses: For Navy Projects, complete the applicable documentation in NAVFAC Contractor Incident Reporting System (CIRS), and electronically submit via the NAVFAC Enterprise Safety Applications Management System (ESAMS). For Army projects, report all "Near Misses" to the GDA, using local mishap reporting procedures, within 24 hrs. Near miss reports are considered positive and proactive Contractor safety management actions.
- c. Conduct an accident investigation for any load handling equipment accident (including rigging accidents) to establish the root cause(s) of the accident. Complete the LHE Accident Report (Crane and Rigging Accident Report) form and provide the report to the Contracting Officer within 30 calendar days of the accident. Do not proceed with crane operations until cause is determined and corrective actions have been implemented to the satisfaction of the Contracting Officer. The Contracting Officer will provide a blank copy of the accident report form.

1.13.3 LHE Inspection Reports

Submit LHE inspection reports required in accordance with EM 385-1-1 and as specified herein with Daily Reports of Inspections.

1.13.4 Certificate of Compliance and Pre-lift Plan/Checklist for LHE and Rigging

Provide a FORM 16-1 Certificate of Compliance for LHE entering an activity under this Contract and in accordance with EM 385-1-1. Post certifications on the crane.

Develop a Standard Lift Plan (SLP) in accordance with EM 385-1-1, Section 16.H.03 using Form 16-2 Standard Pre-Lift Crane Plan/Checklist for each lift planned. Submit SLP to the Contracting Officer for approval within 15 calendar days in advance of planned lift.

1.13.5 Third Party Certification of Floating Cranes and Barge-Mounted Mobile Cranes

Floating cranes and barge-mounted mobile cranes used to perform work under

the terms of this Contract must be certified in accordance with 29 CFR 1919 by an OSHA accredited person prior to submitting the required Lift Plan. Include proof of certification with the initial Lift Plan submission.

1.14 HOT WORK

1.14.1 Permit and Personnel Requirements

Submit and obtain a written permit prior to performing "Hot Work" (i.e. welding or cutting) or operating other flame-producing/spark producing devices, from the Fire Division. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. Provide at least two 20 pound 4A:20 BC rated extinguishers for normal "Hot Work". The extinguishers must be current inspection tagged, and contain an approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch must be trained in accordance with NFPA 51B and remain on-site for a minimum of one hour after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency Fire Division phone number. REPORT ANY FIRE, NO MATTER HOW SMALL, TO THE RESPONSIBLE FIRE DIVISION IMMEDIATELY.

1.14.2 Work Around Flammable Materials

Obtain permit approval from a NFPA Certified Marine Chemist for "HOT WORK" within or around flammable materials (such as fuel systems or welding/cutting on fuel pipes) or confined spaces (such as sewer wet wells, manholes, or vaults) that have the potential for flammable or explosive atmospheres.

Whenever these materials, except beryllium and chromium (VI), are encountered in indoor operations, local mechanical exhaust ventilation systems that are sufficient to reduce and maintain personal exposures to within acceptable limits must be used and maintained in accordance with manufacturer's instruction and supplemented by exceptions noted in EM 385-1-1, Section 06.H

1.15 RADIATION SAFETY REQUIREMENTS

Submit License Certificates, employee training records, and Leak Test Reports for radiation materials and equipment to the Contracting Officer and Radiation Safety Office (RSO), and Contracting Oversight Technician (COT) for all specialized and licensed material and equipment proposed for use on the construction project (excludes portable machine sources of ionizing radiation including moisture density and X-Ray Fluorescence (XRF)). Maintain on-site records whenever licensed radiological materials or ionizing equipment are on Government property.

Protect workers from radiation exposure in accordance with 10 CFR 20, ensuring any personnel exposures are maintained As Low As Reasonably Achievable.

1.15.1 Radiography Operation Planning Work Sheet

Submit a Gamma and X-Ray Radiography Operation Planning Work Sheet to

Contracting Officer 14 days prior to commencement of operations involving radioactive materials or radiation generating devices. For portable machine sources of ionizing radiation, including moisture density and XRF, use and submit the Portable Gauge Operations Planning Worksheet instead. The Contracting Officer and COT will review the submitted worksheet and provide questions and comments.

Contractors must use primary dosimeters process by a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory.

1.15.2 Site Access and Security

Coordinate site access and security requirements with the Contracting Officer and COT for all radiological materials and equipment containing ionizing radiation that are proposed for use on a government facility. For gamma radiography materials and equipment, a Government escort is required for any travels on the Installation. The Navy COT or Government authorized representative will meet the Contractor at a designated location outside the Installation, ensure safety of the materials being transported, and will escort the Contractor for gamma sources onto the Installation, to the job site, and off the Installation. For portable machine sources of ionizing radiation, including moisture density and XRF, the Navy COT or Government authorized representative will meet the Contractor at the job site.

Provide a copy of all calibration records, and utilization records to the COT for radiological operations performed on the site.

1.15.3 Loss or Release and Unplanned Personnel Exposure

Loss or release of radioactive materials, and unplanned personnel exposures must be reported immediately to the Contracting Officer, RSO, and Base Security Department Emergency Number.

1.15.4 Site Demarcation and Barricade

Properly demark and barricade an area surrounding radiological operations to preclude personnel entrance, in accordance with EM 385-1-1, Nuclear Regulatory Commission, and Applicable State regulations and license requirements, and in accordance with requirements established in the accepted Radiography Operation Planning Work Sheet.

Do not close or obstruct streets, walks, and other facilities occupied and used by the Government without written permission from the Contracting Officer.

1.15.5 Security of Material and Equipment

Properly secure the radiological material and ionizing radiation equipment at all times, including keeping the devices in a properly marked and locked container, and secondarily locking the container to a secure point in the Contractor's vehicle or other approved storage location during transportation and while not in use. While in use, maintain a continuous visual observation on the radiological material and ionizing radiation equipment. In instances where radiography is scheduled near or adjacent to buildings or areas having limited access or one-way doors, make no assumptions as to building occupancy. Where necessary, the Contracting Officer will direct the Contractor to conduct an actual building entry, search, and alert. Where removal of personnel from such a building cannot

be accomplished and it is otherwise safe to proceed with the radiography, position a fully instructed employee inside the building or area to prevent exiting while external radiographic operations are in process.

1.15.6 Transportation of Material

Comply with 49 CFR 173 for Transportation of Regulated Amounts of Radioactive Material. Notify Local Fire authorities and the site Radiation Safety Officer (RSO) of any Radioactive Material use.

1.15.7 Schedule for Exposure or Unshielding

Actual exposure of the radiographic film or unshielding the source must not be initiated until after 5 p.m. on weekdays.

1.15.8 Transmitter Requirements

Adhere to the base policy concerning the use of transmitters, such as radios and cell phones. Obey Emissions control (EMCON) restrictions.

1.16 CONFINED SPACE ENTRY REQUIREMENTS

Confined space entry must comply with Section 34 of EM 385-1-1, OSHA 29 CFR 1926, OSHA 29 CFR 1910, OSHA 29 CFR 1910.146, and OSHA Directive CPL 2.100. Any potential for a hazard in the confined space requires a permit system to be used.

1.16.1 Entry Procedures

Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. Comply with EM 385-1-1, Section 34 for entry procedures. Hazards pertaining to the space must be reviewed with each employee during review of the AHA.

1.16.2 Forced Air Ventilation

Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its action level.

1.16.3 Sewer Wet Wells

Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

1.16.4 Rescue Procedures and Coordination with Local Emergency Responders

Develop and implement an on-site rescue and recovery plan and procedures. The rescue plan must not rely on local emergency responders for rescue from a confined space.

1.17 DIVE SAFETY REQUIREMENTS

Develop a Dive Operations Plan, AHA, emergency management plan, and personnel list that includes qualifications, for each separate diving operation. Submit these documents to the District Dive Coordinator (DDC)

via the Contracting Officer, for review and approval at least 15 working days prior to commencement of diving operations. These documents must be at the diving location at all times. Provide each of these documents as a part of the project file.

1.18 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must comply with the applicable Storm Plan and:

- a. Secure outside equipment and materials and place materials that could be damaged in protected areas.
- b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.
- c. Ensure that temporary erosion controls are adequate.

PART 2 PRODUCTS

2.1 CONFINED SPACE SIGNAGE

Provide permanent signs integral to or securely attached to access covers for new permit-required confined spaces. Signs for confined spaces must comply with NEMA Z535.2. Provide signs with wording:
"DANGER--PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" in bold letters a minimum of one inch in height and constructed to be clearly legible with all paint removed. The signal word "DANGER" must be red and readable from 5 feet.

PART 3 EXECUTION

3.1 CONSTRUCTION AND OTHER WORK

Comply with EM 385-1-1, NFPA 70, NFPA 70E, NFPA 241, the APP, the AHA, Federal and State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

PPE is governed in all areas by the nature of the work the employee is performing. Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks. Safety glasses must be worn or carried/available on each person. Mandatory PPE includes:

- a. Hard Hat
- b. Long Pants
- c. Appropriate Safety Shoes
- d. Appropriate Class Reflective Vests

3.1.1 Worksite Communication

Employees working alone in a remote location or away from other workers must be provided an effective means of emergency communications (i.e., cellular phone, two-way radios, land-line telephones or other acceptable

means). The selected communication must be readily available (easily within the immediate reach) of the employee and must be tested prior to the start of work to verify that it effectively operates in the area/environment. Develop an employee check-in/check-out communication procedure to ensure employee safety.

3.1.2 Hazardous Material Use

Each hazardous material must receive approval from the Contracting Office or their designated representative prior to being brought onto the job site or prior to any other use in connection with this Contract. Allow a minimum of 10 working days for processing of the request for use of a hazardous material.

3.1.3 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this Contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint, and hexavalent chromium, are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Contracting Officer approval. Notify the Radiation Safety Officer (RSO) prior to excepted items of radioactive material and devices being brought on base.

3.1.4 Unforeseen Hazardous Material

Contract documents identify materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e. 29 CFR Part 1910.1000). If material(s) that may be hazardous to human health upon disturbance are encountered during construction operations, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to FAR 52.243-4 Changes and FAR 52.236-2 Differing Site Conditions.

3.2 UTILITY OUTAGE REQUIREMENTS

Apply for utility outages at least 14 days in advance. At a minimum, the written request must include the location of the outage, utilities being affected, duration of outage, any necessary sketches, and a description of the means to fulfill energy isolation requirements in accordance with EM 385-1-1, Section 11.A.02 (Isolation). Some examples of energy isolation devices and procedures are highlighted in EM 385-1-1, Section 12.D. In accordance with EM 385-1-1, Section 12.A.01, where outages involve Government or Utility personnel, coordinate with the Government on all activities involving the control of hazardous energy.

These activities include, but are not limited to, a review of HECF and HEC procedures, as well as applicable Activity Hazard Analyses (AHAs). In

accordance with EM 385-1-1, Section 11.A.02 and NFPA 70E, work on energized electrical circuits must not be performed without prior Government authorization. Government permission is considered through the permit process and submission of a detailed AHA. Energized work permits are considered only when de-energizing introduces additional or increased hazard or when de-energizing is infeasible.

3.3 OUTAGE COORDINATION MEETING

After the utility outage request is approved and prior to beginning work on the utility system requiring shut-down, conduct a pre-outage coordination meeting in accordance with EM 385-1-1, Section 12.A. This meeting must include the Prime Contractor, the Prime and subcontractors performing the work, the Contracting Officer, and the Installation representative. All parties must fully coordinate HEC activities with one another. During the coordination meeting, all parties must discuss and coordinate on the scope of work, HEC procedures (specifically, the lock-out/tag-out procedures for worker and utility protection), the AHA, assurance of trade personnel qualifications, identification of competent persons, and compliance with HECP training in accordance with EM 385-1-1, Section 12.C. Clarify when personal protective equipment is required during switching operations, inspection, and verification.

3.4 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Provide and operate a Hazardous Energy Control Program (HECP) in accordance with EM 385-1-1 Section 12, 29 CFR 1910.333, 29 CFR 1915.89, ASSP A10.44, NFPA 70E, and paragraph HAZARDOUS ENERGY CONTROL PROGRAM (HECP).

3.4.1 Safety Preparatory Inspection Coordination Meeting with the Government or Utility

For electrical distribution equipment that is to be operated by Government or Utility personnel, the Prime Contractor and the subcontractor performing the work must attend the safety preparatory inspection coordination meeting, which will also be attended by the Contracting Officer's Representative, and required by EM 385-1-1, Section 12.A.02. The meeting will occur immediately preceding the start of work and following the completion of the outage coordination meeting. Both the safety preparatory inspection coordination meeting and the outage coordination meeting must occur prior to conducting the outage and commencing with lockout/tagout procedures.

3.4.2 Lockout/Tagout Isolation

Where the Government or Utility performs equipment isolation and lockout/tagout, the Contractor must place their own locks and tags on each energy-isolating device and proceed in accordance with the HECP. Before any work begins, both the Contractor and the Government or Utility must perform energy isolation verification testing while wearing required PPE detailed in the Contractor's AHA and required by EM 385-1-1, Sections 05.I and 11.B. Install personal protective grounds, with tags, to eliminate the potential for induced voltage in accordance with EM 385-1-1, Section 12.E.06.

3.4.3 Lockout/Tagout Removal

Upon completion of work, conduct lockout/tagout removal procedure in

accordance with the HECF. In accordance with EM 385-1-1, Section 12.E.08, each lock and tag must be removed from each energy isolating device by the authorized individual or systems operator who applied the device. Provide formal notification to the Government (by completing the Government form if provided by Contracting Officer's Representative), confirming that steps of de-energization and lockout/tagout removal procedure have been conducted and certified through inspection and verification. Government or Utility locks and tags used to support the Contractor's work will not be removed until the authorized Government employee receives the formal notification.

3.5 FALL PROTECTION PROGRAM

Establish a fall protection program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify roles and responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures in accordance with ASSP Z359.2 and EM 385-1-1, Sections 21.A and 21.D.

3.5.1 Training

Institute a fall protection training program. As part of the Fall Protection Program, provide training for each employee who might be exposed to fall hazards and using personal fall protection equipment. Provide training by a competent person for fall protection in accordance with EM 385-1-1, Section 21.C. Document training and practical application of the competent person in accordance with EM 385-1-1, Section 21.C.04 and ASSP Z359.2 in the AHA.

3.5.2 Fall Protection Equipment and Systems

Enforce use of personal fall protection equipment and systems designated (to include fall arrest, restraint, and positioning) for each specific work activity in the Site Specific Fall Protection and Prevention Plan and AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21.

Provide personal fall protection equipment, systems, subsystems, and components that comply with EM 385-1-1 Section 21.I, 29 CFR 1926.500 Subpart M, ASSP Z359.0, ASSP Z359.1, ASSP Z359.2, ASSP Z359.3, ASSP Z359.4, ASSP Z359.6, ASSP Z359.7, ASSP Z359.11, ASSP Z359.12, ASSP Z359.13, ASSP Z359.14, ASSP Z359.15, ASSP Z359.16 and ASSP Z359.18.

3.5.2.1 Additional Personal Fall Protection Measures

In addition to the required fall protection systems, other protective measures such as safety skiffs, personal floatation devices, and life rings, are required when working above or next to water in accordance with EM 385-1-1, Sections 21.0 through 21.0.06. Personal fall protection systems and equipment are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall protection systems are required when operating other equipment such as scissor lifts. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, travel, or while performing work.

3.5.2.2 Personal Fall Protection Equipment

Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. The use of body belts is not acceptable. Harnesses must have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Snap hooks and carabineers must be self-closing and self-locking, capable of being opened only by at least two consecutive deliberate actions and have a minimum gate strength of 3,600 lbs in all directions. Use webbing, straps, and ropes made of synthetic fiber. The maximum free fall distance when using fall arrest equipment must not exceed 6 feet, unless the proper energy absorbing lanyard is used. Always take into consideration the total fall distance and any swinging of the worker (pendulum-like motion), that can occur during a fall, when attaching a person to a fall arrest system. Equip all full body harnesses with Suspension Trauma Preventers such as stirrups, relief steps, or similar in order to provide short-term relief from the effects of orthostatic intolerance in accordance with EM 385-1-1, Section 21.I.06.

3.5.3 Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

- (1) For work within 6 feet from unprotected edge of a roof having a slope less than or equal to 4:12 (vertical to horizontal), protect personnel from falling by the use of conventional fall protection systems (personal fall arrest/restraint systems, guardrails, or safety nets) in accordance with EM 385-1-1, Section 21 and 29 CFR 1926.500. A safety monitoring system is not adequate fall protection and is not authorized.
- (2) For work greater than 6 feet from the unprotected roof edge, addition to the use of conventional fall protection systems the use of a warning line system is also permitted, in accordance with 29 CFR 1926.500 and EM 385-1-1, Section 21.L.

b. Steep-Sloped Roofs: Work on a roof having a slope greater than 4:12 (vertical to horizontal) requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also applies to residential or housing type construction.

3.5.4 Horizontal Lifelines (HLL)

Provide HLL in accordance with EM 385-1-1, Section 21.I.08.d.2. Commercially manufactured horizontal lifelines (HLL) must be designed, installed, certified and used, under the supervision of a qualified person, for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500). The competent person for fall protection may (if deemed appropriate by the qualified person) supervise the assembly, disassembly, use and inspection of the HLL system under the direction of the qualified person. Locally manufactured HLLs are not acceptable unless they are custom designed for limited or site specific applications by a Registered Professional Engineer who is

qualified in designing HLL systems.

3.5.5 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1, Section 21.F.01 and 29 CFR 1926 Subpart M.

3.5.6 Rescue and Evacuation Plan and Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue or assisted-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP). The plan must be in accordance with the requirements of EM 385-1-1, ASSP Z359.2, and ASSP Z359.4.

3.6 WORK PLATFORMS

3.6.1 Scaffolding

Provide employees with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Comply with the following requirements:

- a. Scaffold platforms greater than 20 feet in height must be accessed by use of a scaffold stair system.
- b. Ladders commonly provided by scaffold system manufacturers are prohibited for accessing scaffold platforms greater than 20 feet maximum in height.
- c. An adequate gate is required.
- d. Employees performing scaffold erection and dismantling must be qualified.
- e. Scaffold must be capable of supporting at least four times the maximum intended load, and provide appropriate fall protection as delineated in the accepted fall protection and prevention plan.
- f. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward.
- g. Special care must be given to ensure scaffold systems are not overloaded.
- h. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material are prohibited. The first tie-in must be at the height equal to 4 times the width of the smallest dimension of the scaffold base.
- i. Scaffolding other than suspended types must bear on base plates upon wood mudsills (2 in x 10 in x 8 in minimum) or other adequate firm foundation.

- j. Scaffold or work platform erectors must have fall protection during the erection and dismantling of scaffolding or work platforms that are more than 6 feet.
- k. Delineate fall protection requirements when working above 6 feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

3.6.2 Elevated Aerial Work Platforms (AWPs)

Workers must be anchored to the basket or bucket in accordance with manufacturer's specifications and instructions (anchoring to the boom may only be used when allowed by the manufacturer and permitted by the CP). Lanyards used must be sufficiently short to prohibit worker from climbing out of basket. The climbing of rails is prohibited. Lanyards with built-in shock absorbers are acceptable. Self-retracting devices are not acceptable. Tying off to an adjacent pole or structure is not permitted unless a safe device for 100 percent tie-off is used for the transfer.

Use of AWPs must be operated, inspected, and maintained as specified in the operating manual for the equipment and delineated in the AHA. Operators of AWPs must be designated as qualified operators by the Prime Contractor. Maintain proof of qualifications on site for review and include in the AHA.

3.7 EQUIPMENT

3.7.1 Material Handling Equipment (MHE)

- a. Material handling equipment such as forklifts must not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions. Material handling equipment fitted with personnel work platform attachments are prohibited from traveling or positioning while personnel are working on the platform.
- b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions. Material Handling Equipment Operators must be trained in accordance with OSHA 29 CFR 1910, Subpart N.
- c. Operators of forklifts or power industrial trucks must be licensed in accordance with OSHA.

3.7.2 Load Handling Equipment (LHE)

The following requirements apply. In exception, these requirements do not apply to commercial truck mounted and articulating boom cranes used solely to deliver material and supplies (not prefabricated components, structural steel, or components of a systems-engineered metal building) where the lift consists of moving materials and supplies from a truck or trailer to the ground; to cranes installed on mechanics trucks that are used solely in the repair of shore-based equipment; to crane that enter the activity but are not used for lifting; nor to other machines not used to lift loads suspended by rigging equipment. However, LHE accidents occurring during such operations must be reported.

- a. Equip cranes and derricks as specified in EM 385-1-1, Section 16.

- b. Notify the Contracting Officer 15 working days in advance of any LHE entering the activity, in accordance with EM 385-1-1, Section 16.A.02, so that necessary quality assurance spot checks can be coordinated. Prior to cranes entering federal activities, a Crane Access Permit must be obtained from the Contracting Officer. A copy of the permitting process will be provided at the Preconstruction Meeting. Contractor's operator must remain with the crane during the spot check. Rigging gear must be in accordance with OSHA, ASME B30.9 Standards safety standards.
- c. Comply with the LHE manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.
- d. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, ASME B30.8 for floating cranes and floating derricks, ASME B30.9 for slings, ASME B30.20 for below the hook lifting devices and ASME B30.26 for rigging hardware.
- e. When operating in the vicinity of overhead transmission lines, operators and riggers must be alert to this special hazard and follow the requirements of EM 385-1-1 Section 11, and ASME B30.5 or ASME B30.22 as applicable.
- f. Do not use crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane. Additionally, submit a specific AHA for this work to the Contracting Officer. Ensure the activity and AHA are thoroughly reviewed by all involved personnel.
- g. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.
- h. All employees must keep clear of loads about to be lifted and of suspended loads, except for employees required to handle the load.
- i. Use cribbing when performing lifts on outriggers.
- j. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.
- k. A physical barricade must be positioned to prevent personnel access where accessible areas of the LHE's rotating superstructure poses a risk of striking, pinching or crushing personnel.
- l. Maintain inspection records in accordance by EM 385-1-1, Section 16.D, including shift, monthly, and annual inspections, the signature of the person performing the inspection, and the serial number or other identifier of the LHE that was inspected. Records must be available for review by the Contracting Officer.
- m. Maintain written reports of operational and load testing in accordance with EM 385-1-1, Section 16.F, listing the load test procedures used

along with any repairs or alterations performed on the LHE. Reports must be available for review by the Contracting Officer.

- n. Certify that all LHE operators have been trained in proper use of all safety devices (e.g. anti-two block devices).
- o. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. At wind speeds greater than 20 mph, the operator, rigger and lift supervisor must cease all crane operations, evaluate conditions and determine if the lift may proceed. Base the determination to proceed or not on wind calculations per the manufacturer and a reduction in LHE rated capacity if applicable. Include this maximum wind speed determination as part of the activity hazard analysis plan for that operation.
- p. On mobile cranes, lifts where the load weight is greater than 90 percent of the equipment's capacity are prohibited.
- q. Follow FAA guidelines when required based on project location.

3.7.3 Machinery and Mechanized Equipment

- a. Proof of qualifications for operator must be kept on the project site for review.
- b. Manufacture specifications or owner's manual for the equipment must be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Incorporate such additional safety precautions or requirements into the AHAs.

3.7.4 Base Mounted Drum Hoists

- a. Operation of base mounted drum hoists must be in accordance with EM 385-1-1 and ASSP A10.22.
- b. Rigging gear must be in accordance with applicable ASME/OSHA standards.
- c. When used on telecommunication towers, base mounted drum hoists must be in accordance with TIA-1019, TIA-222, ASME B30.7, 29 CFR 1926.552, and 29 CFR 1926.553.
- d. When used to hoist personnel, the AHA must include a written standard operating procedure. Operators must have a physical examination in accordance with EM 385-1-1 Section 16.B.05 and trained, at a minimum, in accordance with EM 385-1-1 Section 16.U and 16.T. The base mounted drum hoist must also comply with OSHA Instruction CPL 02-01-056 and ASME B30.23.
- e. Material and personnel must not be hoisted simultaneously.
- f. Personnel cage must be marked with the capacity (in number of persons) and load limit in pounds.
- g. Construction equipment must not be used for hoisting material or personnel or with trolley/tag lines. Construction equipment may be used for towing and assisting with anchoring guy lines.

3.7.5 Use of Explosives

Explosives must not be used or brought to the project site without prior written approval from the Contracting Officer. Such approval does not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, must be only where directed and in approved storage facilities. These facilities must be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

3.8 EXCAVATIONS

Soil classification must be performed by a competent person in accordance with 29 CFR 1926 and EM 385-1-1.

3.8.1 Utility Locations

Provide a third party, independent, private utility locating company to positively identify underground utilities in the work area in addition to any station locating service and coordinated with the station utility department.

3.8.2 Utility Location Verification

Physically verify underground utility locations, including utility depth, by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within 3 feet of the underground system.

3.8.3 Utilities Within and Under Concrete, Bituminous Asphalt, and Other Impervious Surfaces

Utilities located within and under concrete slabs or pier structures, bridges, parking areas, and the like, are extremely difficult to identify. Whenever Contract work involves chipping, saw cutting, or core drilling through concrete, bituminous asphalt or other impervious surfaces, the existing utility location must be coordinated with station utility departments in addition to location and depth verification by a third party, independent, private locating company. The third party, independent, private locating company must locate utility depth by use of Ground Penetrating Radar (GPR), X-ray, bore scope, or ultrasound prior to the start of demolition and construction. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the Contractor from meeting this requirement.

3.9 ELECTRICAL

Perform electrical work in accordance with EM 385-1-1, Sections 11 and 12.

3.9.1 Conduct of Electrical Work

As delineated in EM 385-1-1, electrical work is to be conducted in a de-energized state unless there is no alternative method for accomplishing the work. In those cases obtain an energized work permit from the Contracting Officer. The energized work permit application must be accompanied by the AHA and a summary of why the equipment/circuit needs to

be worked energized. Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Attach temporary grounds in accordance with ASTM F855 and IEEE 1048. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator is allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method.

When working in energized substations, only qualified electrical workers are permitted to enter. When work requires work near energized circuits as defined by NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves and electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA. Ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.147.

3.9.2 Qualifications

Electrical work must be performed by QP with verifiable credentials who are familiar with applicable code requirements. Verifiable credentials consist of State, National and Local Certifications or Licenses that a Master or Journeyman Electrician may hold, depending on work being performed, and must be identified in the appropriate AHA. Journeyman/Apprentice ratio must be in accordance with State, Local requirements applicable to where work is being performed.

3.9.3 Arc Flash

Conduct a hazard analysis/arc flash hazard analysis whenever work on or near energized parts greater than 50 volts is necessary, in accordance with NFPA 70E.

All personnel entering the identified arc flash protection boundary must be QPs and properly trained in NFPA 70E requirements and procedures. Unless permitted by NFPA 70E, no Unqualified Person is permitted to approach nearer than the Limited Approach Boundary of energized conductors and circuit parts. Training must be administered by an electrically qualified source and documented.

3.9.4 Grounding

Ground electrical circuits, equipment and enclosures in accordance with NFPA 70 and IEEE C2 to provide a permanent, continuous and effective path to ground unless otherwise noted by EM 385-1-1.

Check grounding circuits to ensure that the circuit between the ground and a grounded power conductor has a resistance low enough to permit sufficient current flow to allow the fuse or circuit breaker to interrupt the current.

3.9.5 Testing

Temporary electrical distribution systems and devices must be inspected,

tested and found acceptable for Ground-Fault Circuit Interrupter (GFCI) protection, polarity, ground continuity, and ground resistance before initial use, before use after modification and at least monthly. Monthly inspections and tests must be maintained for each temporary electrical distribution system, and signed by the electrical CP or QP.

-- End of Section --

SECTION 01 35 29.13

HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES
11/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API RP 2219	(2016) Safe Operation of Vacuum Trucks Handling Flammable and Combustible Liquids in Petroleum Service
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INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1	(2014) American National Standard for Emergency Eyewash and Shower Equipment
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NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 85-115	(1985) Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities
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U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1904	Recording and Reporting Occupational Injuries and Illnesses
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response

Information, and Training Requirements

1.2 PRECONSTRUCTION SAFETY CONFERENCE

Conduct a preconstruction safety conference prior to the start of site activities and after submission of the Accident Prevention Plan/Site Safety And Health Plan (APP/SSHP). The objective of the meeting is to discuss health and safety concerns related to the impending work, discuss project health and safety organization and expectations, review and answer comments and concerns regarding the APP/SSHP or other health and safety concerns. Ensure that those individuals responsible for health and safety at the project level are available and attend this meeting.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Work Zones; G
Decontamination Areas; G

SD-03 Product Data

Amendments to the APP/SSHP
Exposure Monitoring/Air Sampling Program
Site Control Log
SSHO's Daily Inspection Logs

SD-07 Certificates

Certificate Of Worker/Visitor Acknowledgement

SD-11 Closeout Submittals

Safety And Health Phase-Out Report

1.4 ACCIDENT PREVENTION PLAN/SITE SAFETY AND HEALTH PLAN (APP/SSHP)

Develop and implement a Site Safety and Health Plan in accordance with Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, and attach to the Accident Prevention Plan (APP) as an appendix (APP/SSHP). Address all occupational safety and health hazards (traditional construction as well as contaminant-related hazards) associated with cleanup operations within the APP/SSHP. Cover each SSHP element in sections 28.A.01 and 33.B of EM 385-1-1 and each APP element in Appendix A of EM 385-1-1. There are overlapping elements in Section 28.A.01 and Appendix A of EM 385-1-1. SSHP appendix elements that overlap with APP elements need not be duplicated in the APP/SSHP provided each safety and occupational health (SOH) issue receives adequate attention and is documented in the APP/SSHP. The APP/SSHP is a dynamic document, subject to change as project operations/execution change. Modify the APP/SSHP to address changing and previously unidentified health and safety conditions. Ensure that the APP/SSHP is updated accordingly. Submit amendments to the APP/SSHP to the Contracting Officer as the APP/SSHP is updated. For long duration projects resubmit the APP/SSHP to the Contracting Officer

annually for review. The APP/SSHP must contain all updates.

1.4.1 Acceptance and Modifications

Prior to submittal, the APP/SSHP must be signed and dated by the Safety and Health Manager and the Site Superintendent. Submit for review 14 days prior to the Preconstruction Safety Conference. Deficiencies in the APP/SSHP will be discussed at the preconstruction safety conference, and must be revised to correct the deficiencies and resubmitted for acceptance. Onsite work must not begin until the plan has been accepted. Maintain a copy of the written APP/SSHP onsite. Changes and modifications to the APP/SSHP must be made with the knowledge and concurrence of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer. Bring to the attention of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer any unforeseen hazard that becomes evident during the performance of the work, through the Site Safety and Health Officer (SSHO) for resolution as soon as possible. In the interim, take necessary action to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted APP/SSHP is cause for stopping work until the matter has been rectified.

1.4.2 Availability

Make available the APP/SSHP in accordance with 29 CFR 1910.120, (b)(1)(v) and 29 CFR 1926.65, (b)(1)(v).

1.5 STAFF ORGANIZATION, QUALIFICATION AND RESPONSIBILITIES

Provide hazardous waste operations and emergency response organization in accordance with EM 385-1-1, Section 33.

1.5.1 Safety and Health Manager

Safety and Health Manager must be an Industrial Hygienist certified by the American Board of Industrial Hygiene or a safety professional certified by the Board of Certified Safety Professionals.

Apply the following in conjunction with the required qualifications and responsibilities stated in EM 385-1-1, Section 33.C.01.

1.5.1.1 Additional Qualifications

The Safety and Health Manager must have the following qualifications:

- a. A minimum of 3 years experience in developing and implementing safety and occupational health programs at HTRW sites.
- b. Documented experience in supervising professional and technician level personnel.
- c. Documented experience in developing worker exposure assessment programs and air monitoring programs and techniques.
- d. Documented experience in managing personal protective equipment (PPE) programs and conducting PPE hazard evaluations for the types of activities and hazards likely to be encountered on the project.

- e. Working knowledge of state and Federal occupational safety and health regulations.

1.5.1.2 Responsibilities and Duties

- a. Development, implementation, oversight, and enforcement of the APP/SSHP.
- b. Provide onsite consultation as needed to ensure the APP/SSHP is fully implemented.
- c. Conduct initial site-specific training.
- d. Be present onsite during the first 3 days of remedial activities and at the startup of each new major phase of work.
- e. Visit the site as needed and at least once per week for the duration of activities, to audit the effectiveness of the APP/SSHP.
- f. Be available for emergencies.
- g. Coordinate any modifications to the APP/SSHP with the Site Superintendent, the SSHO, and the Contracting Officer.
- h. Be responsible for evaluating air monitoring data and recommending changes to engineering controls, work practices, and PPE.
- i. Provide continued support for upgrading/downgrading of the level of personal protection.
- j. Serve as a member of the quality control staff.
- k. Review accident reports and results of daily inspections.
- l. Sign and date the APP/SSHP prior to submittal.

1.5.2 Site Safety and Health Officer

Designate an individual and one alternate as the Site Safety and Health Officer (SSHO). Include the name, qualifications (education and training summary and documentation), and work experience of the Site Safety and Health Officer and alternate in the APP/SSHP.

The Apply the following in conjunction with the required qualifications and responsibilities stated in EM 385-1-1, Section 33.C.02.

1.5.2.1 Qualifications

The following requirements are in addition to those in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS.

- a. A minimum of 1 year experience in implementing SOH programs at HTRW sites where Level C personal protective equipment was required.
- b. Meet 29 CFR 1910.120/29 CFR 1926.65 requirements for 40-hour initial and 8-hour supervisor training and, maintain 8-hour refresher training requirements.
- c. Specific training in personal and respiratory protective equipment,

confined space entry and in the proper use of air monitoring instruments and air sampling methods including monitoring for ionizing radiation.

- d. Documented experience in construction techniques and construction safety procedures.
- e. Working knowledge of Federal and state occupational SOH regulations.

1.5.2.2 Responsibilities and Duties

The following requirements are in addition to those in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS.

- a. Assist and represent the Safety and Health Manager in onsite training and the day to day onsite implementation and enforcement of the accepted APP/SSHP.
- b. Be assigned to the site on a full time basis for the duration of field activities. The SSHO will have no duties other than SOH related duties. If operations are performed during more than 1 work shift per day, a site Safety and Health Officer must be present for each shift and when applicable, act as the radiation safety officer (RSO) as defined in paragraph 06.F.02 of EM 385-1-1 on radioactive waste cleanup projects.
- c. Have authority to stop work if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions.
- d. Have authority to ensure site compliance with specified SOH requirements, Federal, state and OSHA regulations and all aspects of the APP/SSHP including, but not limited to, activity hazard analyses, air monitoring, monitoring for ionizing radiation, use of PPE, decontamination, site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the emergency response plan, confined space entry procedures, spill containment program, and preparation of records by performing a daily SOH inspection and documenting results on the Daily Safety Inspection Log in accordance with 29 CFR 1904.
- e. In coordination with site management and the Safety and Health Manager, recommend corrective actions for identified deficiencies and oversee the corrective actions.
- f. Consult with and coordinate any modifications to the APP/SSHP with the Safety and Health Manager, the Site Superintendent, and the Contracting Officer.
- g. Conduct daily safety inspection and document SOH findings into the Daily Safety Inspection Log. Track noted SOH deficiencies to ensure that they are corrected.
- h. Conduct accident investigations and prepare accident reports.
- i. Serve as a member of the quality control staff on matters relating to SOH.

1.5.3 Occupational Physician

Utilize the services of a licensed physician, who is certified in occupational medicine by the American Board of Preventative Medicine, or who, by necessary training and experience is Board eligible. The physician must be familiar with the site's hazards and the scope of this project. Include the medical consultant's name, qualifications, and knowledge of the site's conditions and proposed activities in the APP/SSHP. The physician is responsible for the determination of medical surveillance protocols and for review of examination/test results performed in compliance with 29 CFR 1910.120, (f) and 29 CFR 1926.65, (f) and paragraph MEDICAL SURVEILLANCE PROGRAM.

1.5.4 Persons Certified in First Aid and CPR

At least two persons who are currently certified in first aid and CPR by the American Red Cross or other approved agency must be onsite at all times during site operations. They must be trained in universal precautions and the use of PPE as described in the Bloodborne Pathogens Standard of 29 CFR 1910, Section .1030. These persons may perform other duties but must be immediately available to render first aid when needed.

1.5.5 Safety and Health Technicians

For each work crew in the exclusion zone, one person, designated as a Safety and Health technician, must perform activities such as air monitoring, decontamination, and safety oversight on behalf of the SSHO. They must have appropriate training equivalent to the SSHO in each specific area for which they have responsibility and report to and be under the supervision of the SSHO.

1.6 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

Develop and implement an Emergency Response Plan, that meets the requirements of EM 385-1-1 Section 33.G, 29 CFR 1910.120 (1) and 29 CFR 1926.65 (1), as a section of the APP/SSHP. In the event of any emergency associated with remedial action, without delay, alert all onsite employees and as necessary offsite emergency responders that there is an emergency situation; take action to remove or otherwise minimize the cause of the emergency; alert the Contracting Officer; and institute measures necessary to prevent repetition of the conditions or actions leading to, or resulting in, the emergency. Train employees that are required to respond to hazardous emergency situations to their level of responsibility according to 29 CFR 1910.120 (q) and 29 CFR 1926.65 (q) requirements. Rehearse the plan regularly as part of the overall training program for site operations. Review the plan periodically and revised as necessary to reflect new or changing site conditions or information. Provide copies of the Emergency Response Portion of the accepted APP/SSHP to the affected local emergency response agencies. Address, as a minimum, the following elements in the plan:

- a. Pre-emergency planning. Coordinate with local emergency response providers during preparation of the Emergency Response Plan. At a minimum, coordinate with local fire, rescue, hazardous materials response teams, police and emergency medical providers to assure all organizations are capable and willing to respond to and provide services for on-site emergencies. Ensure the Emergency Response Plan for the site is compatible and integrated with the local fire, rescue, medical and police security services available from local emergency

response planning agencies.

- b. Personnel roles, lines of authority, communications for emergencies.
- c. Emergency recognition and prevention.
- d. Site topography, layout, and prevailing weather conditions.
- e. Criteria and procedures for site evacuation (emergency alerting procedures, employee alarm system, emergency PPE and equipment, safe distances, places of refuge, evacuation routes, site security and control).
- f. Route maps to nearest prenotified medical facility. Site-support vehicles must be equipped with maps. At the beginning of project operations, drivers of the support vehicles must become familiar with the emergency route and the travel time required.
- g. Specific procedures for decontamination and medical treatment of injured personnel.
- h. Emergency alerting and response procedures including posted instructions and a list of names and telephone numbers of emergency contacts (physician, nearby medical facility, fire and police departments, ambulance service, Federal, state, and local environmental agencies; as well as Safety and Health Manager, the Site Superintendent, the Contracting Officer and their alternates).
- i. Criteria for initiating community alert program, contacts, and responsibilities.
- j. Procedures for reporting incidents to appropriate government agencies. In the event that an incident such as an explosion or fire, or a spill or release of toxic materials occurs during the course of the project, the appropriate government agencies must be immediately notified. In addition, verbally notify the Contracting Officer and the local district safety office immediately and submit a written notification within 24 hours. Include within the report the following items:
 - (1) Name, organization, telephone number, and location of the Contractor.
 - (2) Name and title of the person(s) reporting.
 - (3) Date and time of the incident.
 - (4) Location of the incident, i.e., site location, facility name.
 - (5) Brief summary of the incident giving pertinent details including type of operation ongoing at the time of the incident.
 - (6) Cause of the incident, if known.
 - (7) Casualties (fatalities, disabling injuries).
 - (8) Details of any existing chemical hazard or contamination.
 - (9) Estimated property damage, if applicable.

- (10) Nature of damage, effect on contract schedule.
- (11) Action taken to ensure safety and security.
- (12) Other damage or injuries sustained, public or private.

k. Procedures for critique of emergency responses and follow-up.

1.7 CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGEMENT

A copy of a certificate of worker/visitor acknowledgement must be completed and submitted for each visitor allowed to enter contamination reduction or exclusion zones, and for each employee, following the Example Certificate Of Worker/Visitor Acknowledgement at the end of this section.

1.8 INSPECTIONS

Attach to and submit with the Daily Quality Control reports the SSHO's Daily Inspection Logs. Include with each entry the following: date, work area checked, employees present in work area, PPE and work equipment being used in each area, special SOH issues and notes, and signature of preparer.

1.9 SAFETY AND HEALTH PHASE-OUT REPORT

Submit a Safety and Health Phase-Out Report in conjunction with the project close out report, prior to final acceptance of the work. Include the following minimum information:

- a. Summary of the overall performance of SOH (e.g., accidents or incidents including near misses, unusual events, lessons learned).
- b. Final decontamination documentation including procedures and techniques used to decontaminate equipment, vehicles, and on site facilities.
- c. Summary of exposure monitoring and air sampling accomplished during the project.
- d. Signatures of Safety and Health Manager and SSHO.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

Comply with EM 385-1-1, 29 CFR 1926.65, 29 CFR 1910.120, OSHA requirements in 29 CFR 1910 and 29 CFR 1926 with work performed under this contract, and state specific OSHA requirements where applicable. Submit to the Contracting Officer for resolution matters of interpretation of standards before starting work. The most stringent requirements apply where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary.

2.2 PERSONAL PROTECTIVE EQUIPMENT

2.2.1 Site Specific PPE Program

Provide onsite personnel exposed to contaminants with appropriate personal protective equipment. Components of levels of protection (B, C, D and

modifications) must be relevant to site-specific conditions, including heat and cold stress potential and safety hazards. Use only respirators approved by NIOSH.

Keep protective equipment and clothing clean and well maintained. Include site-specific procedures to determine PPE program effectiveness and for onsite fit-testing of respirators, cleaning, maintenance, inspection, cartridge change out, and storage of PPE within the PPE section of the APP/SSHP.

2.2.2 Levels of Protection

The Safety and Health Manager must establish and evaluate as the work progresses the levels of protection for each work activity. Also establish action levels for upgrade or downgrade in levels of PPE. Describe in the SSHP the protocols and the communication network for changing the level of protection. Address air monitoring results, potential for exposure, changes in site conditions, work phases, job tasks, weather, temperature extremes, and individual medical considerations within the PPE evaluation protocol.

2.2.2.1 Initial PPE Components

The following items constitute initial minimum protective clothing and equipment ensembles.

Level D	Work uniform consisting of, at a minimum, cotton and cotton and polyester blend long pants and long sleeve shirt or coveralls; safety glasses; work gloves (nitrile gloves while directly handling soil); steel-toed boots; and outer rubber boots or boot covers.
Modified Level D	_____
Level C	_____
Level B	_____

2.2.3 PPE for Government Personnel

Three clean sets of personal protective equipment and clothing (excluding air-purifying negative-pressure respirators and safety shoes, which will be provided by individual visitors), as required for entry into the Exclusion Zone and Contamination Reduction Zone, must be available for use by the Contracting Officer or official visitors. The items must be cleaned, maintained and stored in the clean room of the decontamination facility and clearly marked: "FOR USE BY GOVERNMENT ONLY." Provide basic training in the use and limitations of the PPE provided.

2.3 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

Maintain, as a minimum, the following items onsite and available for immediate use:

- a. First aid equipment and supplies approved by the consulting physician.

- b. Emergency eyewashes and showers that comply with ANSI/ISEA Z358.1.
- c. Emergency-use respirators. For encountering asbestos containing material, half mask air-purifying respirators with P100 cartridges. Dedicate these for emergency use only and maintained onsite in the Contamination Reduction Zone.
- d. Provide fire extinguishers of sufficient size and type at site facilities and in all vehicles and at any other site locations where flammable or combustible materials present a fire risk.

PART 3 EXECUTION

3.1 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

3.1.1 Project/Site Conditions

Refer to the following reports and information for the site description and contamination characterization.

3.1.1.1 CERCLA Documents

Final Study Area Screening Evaluation Addendum Site 19 On Shore Dredge Shipyard, January 2013.

Final Feasibility Study Site 19 On-Shore Dredge Shipyard Operable Unit 12 (OU 12), May 2014

Record of Decision Site 19 - On-Shore Dredge Shipyard Soil and Groundwater (Operable Unit 12), September 2014

3.1.1.2 Predesign Documents

Final Field Investigation Report For NOAA OMAO Ship and Support Facility Relocation, April 2021

NOAA OMAO Ship and Support Facility Relocation Environmental Condition of Property - Area 1

NOAA OMAO Ship and Support Facility Relocation Environmental Condition of Property - Area D

Final Field Investigation Report from the Bulkhead Sampling

3.1.2 Ordnance and Explosives (OE)

Stop work and contact the Contracting Officer if ordnance and explosives (OE), explosive media or chemical agent contaminated media (CACM) are discovered during HTRW site cleanup activities.

3.2 TASK SPECIFIC HAZARDS, INITIAL PPE, HAZWOPER MEDICAL SURVEILLANCE AND TRAINING APPLICABILITY

Task specific occupational hazards, task specific HAZWOPER medical surveillance and training applicability and task specific initial PPE requirements for the project are listed on the Task Hazard and Control Sheets at the end of this section. Reevaluate occupational safety and health hazards as the work progresses and to adjust the PPE and onsite

operations, if necessary, so that the work is performed safely and in compliance with occupational safety and health regulations.

3.3 TRAINING

In conjunction with EM 385-1-1, Section 33D, meet the training program requirements for workers performing cleanup operations and who will be exposed to contaminants.

3.3.1 General HTRW Operations Training

All Personnel performing duties with potential for exposure to onsite contaminants must meet and maintain the following 29 CFR 1910.120/29 CFR 1926.65 (e) training requirements:

- a. 40 hours of off site HTRW instruction.
- b. 3 days actual on-the-job field experience under the direct supervision of a trained, experienced supervisor.
- c. 8 hours refresher training annually.

Onsite supervisors must have an additional 8 hours management and supervisor training specified in 29 CFR 1910.120/29 CFR 1926.65 (e) (4).

3.3.2 Pre-Entry Briefing

Prior to commencement of onsite field activities, all site employees, including those assigned only to the Support Zone, must attend a site-specific SOH training session. This session will be conducted by the Safety and Health Manager and the Site Safety and Health Officer to ensure that all personnel are familiar with requirements and responsibilities for maintaining a safe and healthful work environment. Thoroughly discuss procedures and contents of the accepted APP/SSHP and Sections 01.B.02 and 28.D.03 of EM 385-1-1. Each employee must sign a training log to acknowledge attendance and understanding of the training. Notify the Contracting Officer at least 5 days prior to the initial site-specific training session so government personnel involved in the project may attend.

3.3.3 Periodic Sessions

Conduct periodic onsite training by the SSHO at least weekly for personnel assigned to work at the site during the following week. Address SOH procedures, work practices, any changes in the APP/SSHP, activity hazard analyses, work tasks, or schedule; results of previous week's air monitoring, review of safety discrepancies and accidents. Convene a meeting prior to implementation of the change should an operational change affecting onsite field work be made, to explain SOH procedures. Conduct a site-specific training sessions for new personnel, visitors, and suppliers by the SSHO using the training curriculum outlines developed by the Safety and Health Manager. Each employee must sign a training log to acknowledge attendance and understanding of the training.

3.3.4 Other Training

3.4 MEDICAL SURVEILLANCE PROGRAM

Meet all requirements of 29 CFR 1910.120/29 CFR 1926.65 medical

surveillance program and EM 385-1-1, Section 33.G for workers performing cleanup operations and who will be exposed to contaminants. Ensure the Occupational Physician or the physician's designee performs the physical examinations and reviews examination results. Participation in the medical surveillance program is without cost to the employee, without loss of pay and at a reasonable time and place.

3.5 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

Prepare and implement by the Safety and Health Manager an exposure monitoring/air sampling program to identify and quantify SOH hazards and airborne levels of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment for affected site personnel. Include action levels for upgrading/downgrading PPE in the program. Submit personnel exposure monitoring/sampling results. Monitor for the following gasses and vapors benzene and naphthalene. Monitor for the following aerosolized contaminants arsenic, asbestos, and benzo(a)pyrene.

3.6 HEAT STRESS MONITORING AND MANAGEMENT

Document in the APP/SSHP and implement the procedures and practices in section 06.J. in EM 385-1-1 to monitor and manage heat stress.

3.7 SPILL AND DISCHARGE CONTROL

Develop and implement written spill and discharge containment/control procedures. Address radioactive wastes, shock sensitive wastes, laboratory waste packs, material handling equipment, as well as drum and container handling, opening, sampling, shipping and transport. Describe prevention measures, such as building berms or dikes; spill control measures and material to be used (e.g. booms, vermiculite); location of the spill control material; personal protective equipment required to cleanup spills; disposal of contaminated material; and who is responsible to report the spill. Storage of contaminated material or hazardous materials must be appropriately bermed, diked and contained to prevent any spillage of material on uncontaminated soil. If the spill or discharge is reportable, or human health or the environment are threatened, notify the National Response Center, the state, and the Contracting Officer as soon as possible. Provide control as required by Section 01 57 19 TEMPORARY ENVIRONMENT CONTROLS.

3.8 MATERIALS TRANSFER SAFETY

Remove liquids and residues from the tanks using explosion-proof or air-driven pumps. In accordance with EM 385-1-1, Section 9, electrically bond the tank and ground pump motors and suction hoses to prevent electrostatic ignition hazards. Use of a hand pump will be permitted to remove the last of the liquid from the bottom of the tanks. If a vacuum truck is used for removal of liquids or residues, the area of operation for the vacuum truck must be vapor free. Locate the truck upwind from the tank and outside the path of probable vapor travel. Discharge the vacuum pump exhaust gases through a hose of adequate size and length downwind of the truck and tank area. Vacuum truck operating and safety practices must conform to API RP 2219. Collect tank residues in drums, tanks, or tank trucks labeled according to 49 CFR 171 and 49 CFR 172 and disposed of as specified. Disconnect and drain fittings and lines of their contents after the materials have been transferred and the tanks have been exposed. Do not spill contents into the environment during cutting or

disconnecting of tank fittings. Transfer materials drained into DOT-approved drums for storage and transportation. Use only non-sparking or non-heat producing tools to disconnect and drain or to cut through tank fittings. Electrical equipment (e.g., pumps, portable hand tools) used for tank preparation must be explosion-proof. Following cutting or disconnecting of the fittings, plug openings leading to the tanks.

3.9 SITE CONTROL MEASURES

Coordinate site control measures with Section 01 57 19 TEMPORARY ENVIRONMENT CONTROLS.

3.9.1 Work Zones

Initial anticipated work zone boundaries (exclusion zone, contamination reduction zone, support zone, all access points and decontamination areas) are to be clearly delineated on the site drawings. Base delineation of work zone boundaries on the contamination characterization data and the hazard/risk analysis to be performed as described in EM 385-1-1 06.A.02. As work progresses and field conditions are monitored, work zone boundaries may be modified (and site drawings modified) with approval of the Contracting Officer. Clearly identify work zones and mark in the field (using fences, tape, or signs). Submit and post a site map, showing work zone boundaries and locations of decontamination areas. Work zones must consist of the following:

3.9.1.1 Exclusion Zone (EZ)

The exclusion zone is the area where hazardous contamination is either known or expected to occur and the greatest potential for exposure exists. Control entry into this area and exit may only be made through the Contamination Reduction Zone (CRZ).

3.9.1.2 Contamination Reduction Zone (CRZ)

The CRZ is the transition area between the Exclusion Zone and the Support Zone. The personnel and equipment decontamination areas must be separate and unique areas located in the CRZ.

3.9.1.3 Support Zone (SZ)

The Support Zone is defined as areas of the site, other than exclusion zones and contamination reduction zones, where workers do not have the potential to be exposed to hazardous substances or dangerous conditions resulting from HTRW operations. Secure the Support Zone against active or passive contamination. Site offices, parking areas, and other support facilities must be located in the Support Zone.

3.9.2 Site Control Log

A log of personnel visiting, entering, or working on the site must be maintained. Include the following: date, name, agency or company, time entering and exiting site, time entering and exiting the exclusion zone (if applicable). Before visitors are allowed to enter the Contamination Reduction Zone or Exclusion Zone, they must show proof of current training, medical surveillance and respirator fit testing (if respirators are required for the tasks to be performed) and fill out a Certificate of Worker or Visitor Acknowledgment. Record this visitor information, including date, in the log.

3.9.3 Communication

Provide and install an employee alarm system that has adequate means of on and off site communication in accordance with 29 CFR 1910 Section .165. The means of communication must be able to be perceived above ambient noise or light levels by employees in the affected portions of the workplace. The signals must be distinctive and recognizable as messages to evacuate or to perform critical operations.

3.9.4 Site Security

Print signs in bold large letters on contrasting backgrounds. Signs must be visible from all points where entry might occur and at such distances from the restricted area that employees may read the signs and take necessary protective steps before entering.

3.10 PERSONAL HYGIENE AND DECONTAMINATION

Personnel entering the Exclusion or Contamination Reduction Zones or otherwise exposed to hazardous chemical vapors, gases, liquids, or contaminated solids must decontaminate themselves and their equipment prior to exiting the contamination reduction zone (CRZ) and entering the support zone. Consult Chapter 10.0 of NIOSH 85-115 when preparing decontamination procedures. Submit a detailed discussion of personal hygiene and decontamination areas and procedures to be followed by site workers as part of the APP/SSHP. Train employees in the procedures and enforce the procedures throughout site operations.

3.10.1 Decontamination Areas

Submit drawings showing the layout of the personnel and equipment decontamination areas.

3.10.2 Personnel Decontamination

Initially set up a decontamination line in the CRZ. Employees must exit the exclusion zone through the CRZ and implement the following decontamination procedures and techniques: Scrub and rinse rubber boots or removed boot covers, remove all outer garments and hand and face wash. Showers, if needed, must comply with 29 CFR 1910, Section.141 and EM 385-1-1, 02 F, Washing Facilities. It is the Site Safety and Health Officer's responsibility to recommend techniques to improve personnel decontamination procedures, if necessary. Initial personnel decontamination equipment includes the following: hand and face wash station, water source, and scrub brushes.

3.10.3 Equipment Decontamination

Decontaminate the vehicles and equipment used in the EZ in the CRZ prior to leaving the EZ.

3.10.3.1 Facilities for Equipment and Personnel

Provide a vehicle/equipment decontamination station within the CRZ for decontaminating vehicles and equipment leaving the EZ.

3.10.3.2 Procedures

Procedures for equipment decontamination must be developed and utilized to prevent the spread of contamination into the SZ and offsite areas. These procedures must address disposal of contaminated products and spent materials used on the site, including, as a minimum, containers, fluids, and oils. Assume any item taken into the EZ to be contaminated and perform an inspection and decontaminate. Vehicles, equipment, and materials must be cleaned and decontaminated prior to leaving the site. Handle construction material in such a way as to minimize the potential for contaminants being spread or carried offsite. Prior to exiting the site, vehicles and equipment must be monitored to ensure the adequacy of decontamination.

Task Hazard and Control Requirements Sheet	
Task	
Initial Anticipated Hazards	
Initial PPE	
Initial Controls	
Initial Exposure Monitoring	
[Yes][No]	HAZWOPER Medical Surveillance Required
[Yes][No]	HAZWOPER Training Required

-- End of Section --

SECTION 01 35 40.00 20

MARINE MAMMAL PROTECTION

11/22

PART 1 GENERAL

Marine mammal monitoring and underwater acoustic monitoring are required for pile installation and removal activities and are intended to reduce the risks of exposing marine mammals to dangerous levels of underwater noise.

1.1 DEFINITIONS

Definitions pertaining to sustainable development are as defined in as specified.

- a. Endangered: Defined under the Endangered Species Act of 1973 (ESA) as "any species which is in danger of extinction throughout all or a significant portion of its range."
- b. Harassment: Under the 1994 Amendments to the MMPA, harassment is statutorily defined as, any act of pursuit, torment, or annoyance which:

Level A Harassment - has the potential to injure a marine mammal or marine mammal stock in the wild; Level A harassment or,

Level B Harassment - has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild.

- c. Incidental Taking: An unintentional, but not unexpected, taking.
- d. Line of Sight: An imaginary unobstructed straight line running from the starting point to the horizon.
- e. Marine Environment: The oceans and the seas, including estuarine and brackish waters.
- f. Marine Mammal:
 - (A) is morphologically adapted to the marine environment cetaceans (whales, porpoise, dolphin), the sirenians (sea-cows, including manatees and dugong) and the pinnipeds (the carnivores of the group, seals, sealions, walruses), or
 - (B) primarily inhabits the marine environment (such as the polar bear and the sea otter).
- g. Marine Mammal Commission: A three-member panel appointed by the President to oversee implementation of the MMPA, and provide scientific advice to the Secretaries of Commerce and Interior. All permit applications for scientific research must be reviewed by the Commission and its 10-member Committee of Scientific Advisors on

Marine Mammals.

- h. MMPA: Marine Mammal Protection Act of 1972, as amended, 16 U.S.C. 1361 et seq.
- i. Shutdown Zone: During all pile installation and removal activities, a 33-foot (10-meter) physical shutdown zone around each active pile will be implemented to protect animals from physical and acoustic injury.
- j. Monitoring Zone: The designated area for marine mammal monitoring for all specified pile installation and removal activities, as defined in the Incidental Harassment Authorization (IHA) issued by the National Marine Fisheries Service (NMFS) included as part of this specification.
- k. Take: The MMPA states that the term "take" means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal. According to the ESA, the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.
- l. Threatened: Defined under the ESA as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification; submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Marine Mammal Monitoring Plan; G

Acoustic Monitoring Plan; G

Protected Species Observer Qualifications; G

SD-09 Manufacturer's Field Reports

Draft Marine Mammal Monitoring and Acoustic Monitoring Reports; G

Marine Mammal Monitoring Data Collection Forms; G

SD-11 Closeout Submittals

Marine Mammal Monitoring and Acoustic Monitoring Final Reports

1.2.1 Marine Mammal Monitoring Plan and Acoustic Monitoring Plan

Prepare a Marine Mammal Monitoring Plan and an Acoustic Monitoring Plan in accordance with the NMFS-issued IHA. Submit the plans to the Contracting Officer for transmittal to NMFS. The plans must be approved by NMFS prior to initiation of pile driving.

1.2.2 Protected Species Observer Qualifications

Submit the Observer qualifications and experience for National Marine

Fisheries Service (NMFS) approval prior to start of construction.

1.2.3 Marine Mammal Monitoring Data Collection Forms

Data collection forms must be submitted with the Draft Marine Mammal Monitoring Report in accordance with the NMFS-issued IHA.

1.2.4 Draft Marine Mammal Monitoring and Acoustic Monitoring Reports

Draft Marine Mammal Monitoring and Acoustic Monitoring Reports, prepared in accordance with the NMFS-issued IHA, must be furnished to the installation environmental office point of contact within a mutually agreeable timeframe and allowing for submittal to NMFS within 90 calendar days after the activity year specified in the NMFS-issued IHA, or 60 calendar days prior to the requested issuance of any subsequent IHA for construction activity at the same location, whichever comes first. NMFS comments must be addressed and revisions submitted within 30 days after receiving NMFS comments.

1.2.5 Marine Mammal Monitoring and Acoustic Monitoring Final Reports

If a subsequent IHA is requested for construction activity beyond the NMFS-issued IHA activity year at the same location, submit all data forms and a comprehensive summary report of the marine mammal and acoustic monitoring that was conducted and an estimate of the number of marine mammals that may have been harassed throughout the entire project.

1.3 REGULATORY REQUIREMENTS

The Marine Mammal Protection Act, 16 U.S.C. §1361, is a U.S. law, enacted in 1972, to protect marine-dwelling mammals, including whales, dolphins, seals, walruses, sea lions, sea otters, polar bears, dugongs and manatees. The MMPA prohibits the importation or "taking" of these animals, where "take" is defined as "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill." The MMPA is administered by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service

The species most commonly found, but not limited to this area are harbor and gray seals. They have been documented transiting through the waters adjacent to NAVSTA Newport which could be affected by acoustic disturbance due to in-water construction operations.

1.4 MARINE MAMMAL MONITORING PLAN AND ACOUSTIC MONITORING PLAN

The Marine Mammal Monitoring Plan and the Acoustic Monitoring Plan (two plans) for the NOAA Pier construction at Naval Station Newport are a requirement of the IHA issued under the MMPA. The plans must be adhered to in their entirety and cannot be modified without NMFS approval.

-- End of Section --

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SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

02/19

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization (e.g., ASTM B564 Standard Specification for Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

ACOUSTICAL SOCIETY OF AMERICA (ASA)
1305 Walt Whitman Road, Suite 300
Melville, NY 11747-4300
Ph: 516-576-2360
Fax: 631-923-2875
E-mail: asa@acousticalsociety.org
Internet: <https://acousticalsociety.org/>

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)
1600 Boston-Providence Hwy
Walpole, MA 02081
Ph: 1-866-956-5888
Fax: 1-866-956-5819
Internet: <https://www.airbarrier.org/>

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)
30 West University Drive
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
E-mail: communications@amca.org
Internet: <http://www.amca.org>

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)
2111 Wilson Blvd, Suite 400
Arlington, VA 22201
Ph: 703-524-8800
Internet: <http://www.ahrinet.org>

ALUMINUM ASSOCIATION (AA)
1400 Crystal Drive
Suite 430

Arlington, VA 22202
Ph: 703-358-2960
E-Mail: info@aluminum.org
Internet: <https://www.aluminum.org/>

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1900 E Golf Rd, Suite 1250
Schaumburg, IL 60173
Ph: 847-303-5664
E-mail: customerservice@aamanet.org
Internet: <https://aamanet.org/>

AMERICAN ASSOCIATION OF RADON SCIENTISTS AND TECHNOLOGISTS (AARST)
475 South Church Street - Suite 600
Hendersonville, NC 28792
Ph: 800-269-4174
Fax: 828-214-6299
E-mail: info@aarst.org
Internet: <http://aarst-nrpp.com/wp/>

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806
E-Mail: info@aaashto.org
Internet: <https://www.transportation.org/>

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)
1 Davis Drive
P.O. Box 12215
Research Triangle Park, NC 27709-2215
Ph: 919-549-8141
Fax: 919-549-8933
Internet: <https://www.aatcc.org/>

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
330 N. Wabash Ave., Suite 2000
Chicago, IL 60611
Ph: 202-367-1155
E-mail: info@americanbearings.org
Internet: <https://www.americanbearings.org/>

AMERICAN CONCRETE INSTITUTE (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331-3439
Ph: 248-848-3700
Fax: 248-848-3701
Internet: <https://www.concrete.org/>

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)
8445 Freeport Parkway, Suite 350
Irving, TX 75063-2595
Ph: 972-506-7216
Fax: 972-506-7682
E-mail: info@concrete-pipe.org
Internet: <https://www.concretepipe.org/>

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Drive
Cincinnati, OH 45240
Ph: 513-742-2020
Fax: 513-742-3355
Internet: <https://www.acgih.org/>

AMERICAN GAS ASSOCIATION (AGA)
400 North Capitol Street, NW
Suite 450
Washington, D.C. 20001
Ph: 202-824-7000
Internet: <https://www.aga.org/>

AMERICAN HARDBOARD ASSOCIATION (AHA)
1210 West Northwest Highway
Palatine, IL 60067
Ph: 847-934-8800
Fax: 847-934-8803
E-mail: aha@hardboard.org
Internet: <http://domensino.com/AHA/>

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
130 East Randolph, Suite 2000
Chicago, IL 60601
Ph: 312-670-5444
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AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
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AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
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INTERNATIONAL WINDOW CLEANING ASSOCIATION (IWCA)
7918 Jones Branch Dr, Ste 300
McLean, VA 22102
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E-mail: customerservice@sae.org
Internet: <https://www.sae.org/>

SOCIETY OF CABLE TELECOMMUNICATIONS ENGINEERS (SCTE)
140 Philips Road
Exton, PA 19341-1318
Ph: 800-542-5040 or 610-363-6888
Fax: 610-884-7237
E-Mail: info@scte.org
Internet: <https://www.scte.org/>

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
21865 Copley Drive
Diamond Bar, CA 91765
Ph: 909-396-2000
E-mail: webinquiry@aqmd.gov
Internet: <http://www.aqmd.gov>

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)
665 Rodi Road, Suite 305
Pittsburgh, PA 15235
Ph: 412-244-0440
Fax: 412-244-9090
Internet: <http://www.cypressinfo.org>

SOUTHERN PINE INSPECTION BUREAU (SPIB)
P.O. Box 10915
Pensacola, FL 32524-0915
Ph: 850-434-2611 or 800-995-7742
Fax: 850-434-1290
E-mail: spib@spib.org
Internet: <https://www.spib.org/>

STEEL DECK INSTITUTE (SDI)
P.O. Box 426
Glenshaw, PA 15116
Ph: 412-487-3325
Fax: 412-487-3326
Internet: <https://www.sdi.org/>

STEEL DOOR INSTITUTE (SDI/DOOR)
30200 Detroit Road
Westlake, OH 44145
Ph: 440-899-0010
Fax: 440-892-1404
E-mail: info@steeldoors.org
Internet: <https://www.steeldoors.org/>

STEEL JOIST INSTITUTE (SJI)
234 W. Cheves Street
Florence, SC 29501
Ph: 843-407-4091
Internet: <https://steeljoist.org/>

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)
15 Technology Parkway South, Suite 115
Peachtree Corners, GA 30092
Ph: 800-332-8686 or 770-446-1400
Fax: 770-446-6947
E-mail: memberconnection@tappi.org
Internet: <http://www.tappi.org>

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)
1320 North Courthouse Road, Suite 200
Arlington, VA 22201
Ph: 703-907-7700
Fax: 703-907-7727
E-mail: marketing@tiaonline.org
Internet: <https://www.tiaonline.org/>

THE MASONRY SOCIETY (TMS)
105 South Sunset Street, Suite Q
Longmont, CO 80501-6172
Ph: 303-939-9700
Fax: 303-541-9215
E-mail: info@masonrysociety.org
<https://masonrysociety.org/>

TILE COUNCIL OF NORTH AMERICA (TCNA)
100 Clemson Research Boulevard
Anderson, SC 29625
Ph: 864-646-8453
Fax: 864-646-2821

E-mail: info@tileusa.com
Internet: <https://www.tcnatile.com/>

TREE CARE INDUSTRY ASSOCIATION (TCIA)
136 Harvey Road, Suite 101
Londonderry, NH 03053
Ph: 603-314-5380 or 800-733-2622
Fax: 603-314-5386
Internet: <https://tcia.org/>

U.S. ARMY CORPS OF ENGINEERS (USACE)
CRD-C DOCUMENTS available on Internet:
<http://www.wbdg.org/ffc/army-coe/standards>
Order Other Documents from:
Official Publications of the Headquarters, USACE
E-mail: hqpublications@usace.army.mil
Internet: <http://www.publications.usace.army.mil/>
or
<https://www.hnc.usace.army.mil/Missions/Engineering-Directorate/TECHINFO/>

U.S. DEFENSE LOGISTICS AGENCY (DLA)
Andrew T. McNamara Building
8725 John J. Kingman Road
Fort Belvoir, VA 22060-6221
Ph: 877-352-2255
E-mail: dlacontactcenter@dla.mil
Internet: <http://www.dla.mil>

U.S. DEPARTMENT OF AGRICULTURE (USDA)
Order AMS Publications from:
AGRICULTURAL MARKETING SERVICE (AMS)
Seed Regulatory and Testing Branch
801 Summit Crossing Place, Suite C
Gastonia, NC 28054-2193
Ph: 704-810-8884
E-mail: PA@ams.usda.gov
Internet: <https://www.ams.usda.gov/>
Order Other Publications from:
USDA Rural Development
Rural Utilities Service
STOP 1510, Rm 5135
1400 Independence Avenue SW
Washington, DC 20250-1510
Phone: (202) 720-9540
Internet:
<https://www.rd.usda.gov/about-rd/agencies/rural-utilities-service>

U.S. DEPARTMENT OF COMMERCE (DOC)
1401 Constitution Avenue, NW
Washington, DC 20230
Ph: 202-482-2000
Internet: <https://www.commerce.gov/>
Order Publications From:
National Technical Information Service (NTIS)
5301 Shawnee Road
Alexandria, VA 22312
Ph: 703-605-6060 or 1-800-363-2068
Fax: 703-605-6880
TDD: 703-487-4639

E-mail: info@ntis.gov
Internet: <https://www.ntis.gov/>

U.S. DEPARTMENT OF DEFENSE (DOD)
Order DOD Documents from:
Room 3A750-The Pentagon
1400 Defense Pentagon
Washington, DC 20301-1400
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Fax: 215-697-1462
E-mail: customerservice@ntis.gov
Internet: <https://www.ntis.gov/>
Obtain Military Specifications, Standards and Related Publications
from:
Acquisition Streamlining and Standardization Information System
(ASSIST)
Department of Defense Single Stock Point (DODSSP)
Document Automation and Production Service (DAPS)
Building 4/D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-6396 - for account/password issues
Internet: <https://assist.dla.mil/online/start/>; account
registration required
Obtain Unified Facilities Criteria (UFC) from:
Whole Building Design Guide (WBDG)
National Institute of Building Sciences (NIBS)
1090 Vermont Avenue NW, Suite 700
Washington, DC 20005
Ph: 202-289-7800
Fax: 202-289-1092
Internet:
<https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc>

U.S. DEPARTMENT OF ENERGY (DOE)
1000 Independence Avenue Southwest
Washington, D.C. 20585
Ph: 202-586-5000
Fax: 202-586-4403
E-mail: The.Secretary@hq.doe.gov
Internet: <https://www.energy.gov/>

U.S. DEPARTMENT OF TRANSPORTATION (DOT)
1200 New Jersey Ave., SE
Washington, DC 20590
Ph: 202-366-4000
Internet: <https://www.transportation.gov/>

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
1200 Pennsylvania Avenue, N.W.
Washington, DC 20004
Ph: 202-564-4700
Internet: <https://www.epa.gov>
--- Some EPA documents are available only from:
National Technical Information Service (NTIS)
5301 Shawnee Road
Alexandria, VA 22312
Ph: 703-605-6060 or 1-800-363-2068
Fax: 703-605-6880

TDD: 703-487-4639
E-mail: info@ntis.gov
Internet: <https://www.ntis.gov/>

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)
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Bookstore: 202-512-0132
Internet: <https://www.gpo.gov/>
Order free documents from:
U.S. Department of Transportation
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591
Ph: 866-835-5322
Internet: <https://www.faa.gov/>

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)
445 12th Street SW
Washington, DC 20554
Ph: 888-225-5322
TTY: 888-835-5322
Fax: 866-418-0232
Internet: <https://www.fcc.gov/>
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Bookstore: 202-512-0132
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U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)
1200 New Jersey Ave., SE
Washington, DC 20590
Ph: 202-366-4000
E-mail: ExecSecretariat.FHWA@dot.gov
Internet: <https://www.fhwa.dot.gov/>
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Washington, DC 20401
Ph: 202-512-1800 or 866-512-1800
Bookstore: 202-512-0132
Internet: <https://www.gpo.gov/>

U.S. GENERAL SERVICES ADMINISTRATION (GSA)
General Services Administration
1800 F Street, NW
Washington, DC 20405
Ph: 1-844-472-4111
Internet: <https://www.gsaelibrary.gsa.gov/ElibMain/home.do>
Obtain documents from:

Acquisition Streamlining and Standardization Information System
(ASSIST)

Internet: <https://assist.dla.mil/online/start/>; account
registration required

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

8601 Adelphi Road

College Park, MD 20740-6001

Ph: 866-272-6272

Internet: <https://www.archives.gov/>

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Washington, DC 20401

Ph: 202-512-1800 or 866-512-1800

Bookstore: 202-512-0132

Internet: <https://www.gpo.gov/>

UL ENVIRONMENT (ULE)

2211 Newmarket Parkway, Suite 106

Marietta, GA 30067

Ph: 888-485-4733

E-mail: environment@ul.com

Intertet: <https://industries.ul.com/environment/>

UNDERWRITERS LABORATORIES (UL)

2600 N.W. Lake Road

Camas, WA 98607-8542

Ph: 877-854-3577 or 360-817-5500

E-mail: CustomerExperienceCenter@ul.com

Internet: <https://www.ul.com/>

UL Directories available through IHS at <https://ihsmarkit.com/>

UNIFIED FACILITIES CRITERIA (UFC)

1090 Vermont Avenue, NW

Suite 700

Washington, DC 20005

Ph: 202-289-7800

Internet:

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

Corporate Headquarters

2711 LBJ Freeway, Suite 1000

Dallas, TX 75234

Ph: 972-243-3902

Fax: 972-243-3907

E-mail: info@uni-bell.org

Internet: <https://www.uni-bell.org/>

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION
(VISCMA)

994 Old Eagle School Road

Suite 1019

Wayne, PA 19087-1866

Ph: 610-971-4850

E-mail: info@viscma.com

Internet: <http://www.viscma.com>

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)
6980 S.W. Varns
Tigard, OR 97223
Ph: 503-639-0651
Fax: 503-684-8928
E-mail: info@wclib.org
Internet: <http://www.wclib.org>

WESTERN WOOD PRESERVERS INSTITUTE (WWPI)
12503 SE Mill Plain Blvd, Ste 205
Vancouver, WA 98684
Ph: 360-693-9958
Internet: <https://wwpinstitute.org/>

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)
1500 SW First Ave., Suite 870
Portland, OR 97201
Ph: 503-224-3930
E-mail: info@wwpa.org
Internet: <http://www.wwpa.org>

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)
2025 M Street, NW, Suite 800
Washington, DC 20036-3309
Ph: 202-367-1157
or
330 N Wabash Avenue, Suite 2000
Chicago, IL 60611
Ph: 312-321-6802
E-mail: membersupport@wdma.com
Internet: <https://www.wdma.com/>

WOODWORK INSTITUTE (WI)
3188 Industrial Blvd.
West Sacramento, CA 95691
Ph: 916-372-9943
Fax: 916-372-9950
E-mail: info@woodinst.com
Internet: <https://woodworkinstitute.com>

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

-- End of Section --

SECTION 01 45 00.00 20

QUALITY CONTROL
11/11, CHG 8: 02/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 52.2 (2012) Method of Testing General
Ventilation Air-Cleaning Devices for
Removal Efficiency by Particle Size

ASTM INTERNATIONAL (ASTM)

ASTM D6245 (2012) Using Indoor Carbon Dioxide
Concentrations to Evaluate Indoor Air
Quality and Ventilation

ASTM D6345 (2010) Standard Guide for Selection of
Methods for Active, Integrative Sampling
of Volatile Organic Compounds in Air

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

ANSI/SMACNA 008 (2007) IAQ Guidelines for Occupied
Buildings Under Construction, 2nd Edition

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety -- Safety and Health
Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Construction Quality Control (QC) Plan; G

Indoor Air Quality (IAQ) Management Plan; G

Final IAQ Management Plan; S

1.3 INFORMATION FOR THE CONTRACTING OFFICER

Prior to commencing work on construction, the Contractor can obtain a single copy set of the current report forms from the Contracting Officer. The report forms will consist of the Contractor Production Report, Contractor Production Report (Continuation Sheet), Contractor Quality Control (CQC) Report, CQC Report (Continuation Sheet), Preparatory Phase Checklist, Initial Phase Checklist, Rework Items List, and Testing Plan and Log.

Deliver the following to the Contracting Officer during Construction:

- a. CQC Report: Submit the report electronically by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work.
- b. Contractor Production Report: Submit the report electronically by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work.
- c. Preparatory Phase Checklist: Submit the report electronically in the same manner as the CQC Report for each Preparatory Phase held.
- d. Initial Phase Checklist: Submit the report electronically in the same manner as the CQC Report for each Initial Phase held.
- e. QC Specialist Reports: Submit the report electronically by 10:00 AM the next working day after each day that work is performed.
- f. Field Test Reports: Within two working days after the test is performed, submit the report as an electronic attachment to the CQC Report.
- g. Monthly Summary Report of Tests: Submit the report as an electronic attachment to the CQC Report at the end of each month.
- h. Testing Plan and Log: Submit the report as an electronic attachment to the CQC Report, at the end of each month. Provide a copy of the final Testing Plan and Log to the preparer of the Operation & Maintenance (O&M) documentation.
- i. Rework Items List: Submit lists containing new entries daily, in the same manner as the CQC Report.
- j. CQC Meeting Minutes: Within two working days after the meeting is held, submit the report as an electronic attachment to the CQC Report.
- k. QC Certifications: As required by the paragraph QC CERTIFICATIONS.
- l. Special Inspection Report: Submit the Special Inspection reports, in the same manner as the CQC Report.

1.4 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. This QC program is a key element in meeting the objectives of NAVFAC Commissioning. The QC program consists of a QC Organization, QC Plan, QC Plan Meeting(s), a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and approval, testing,

completion inspections, QC certifications, independent Special Inspections in accordance with Section 01 45 35 SPECIAL INSPECTIONS, and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this Contract. The QC program must cover on-site and off-site work and be keyed to the work sequence. No construction work or testing may be performed unless the QC Manager is on the work site. The QC Manager must report to an officer of the firm and not be subordinate to the Project Superintendent or the Project Manager. The QC Manager, Project Superintendent and Project Manager must work together effectively. Although the QC Manager is the primary individual responsible for quality control, all individuals will be held responsible for the quality of work on the job.

1.4.1 Commissioning

Commissioning (Cx) is a systematic process of ensuring that all building systems meet the requirements and perform interactively according to the Contract. The QC Program is a key in supporting the objectives of the Cx process, specifically to coordinate, document, and verify compliance with contract requirements. Refer to commissioning requirements in Section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING.

1.4.2 Acceptance of the Construction Quality Control (QC) Plan

Acceptance of the QC Plan is required prior to the start of construction. The Contracting Officer reserves the right to require changes in the QC Plan and operations as necessary, including removal of personnel, to ensure the specified quality of work. The Contracting Officer reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications. All QC organization personnel are subject to acceptance by the Contracting Officer. The Contracting Officer may require the removal of any individual for non-compliance with quality requirements specified in the Contract.

1.4.3 Preliminary Construction Work Authorized Prior to Acceptance

The only construction work that is authorized to proceed prior to the acceptance of the QC Plan is mobilization of storage and office trailers, temporary utilities, and surveying.

1.4.4 Notification of Changes

Notify the Contracting Officer, in writing, of any proposed changes in the QC Plan or changes to the QC organization personnel, a minimum of 10 work days prior to a proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

1.4.5 Special Inspections

Perform all required Special Inspections per Section 01 45 35 SPECIAL INSPECTIONS, the statement of Special Inspections and the Schedule of Special Inspections.

1.5 QC ORGANIZATION

1.5.1 QC Manager

1.5.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. The only duties and responsibilities of the QC Manager are to manage and implement the QC program on this Contract. The QC Manager is required to attend the partnering meetings, QC Plan Meetings, Coordination and Mutual Understanding Meeting, conduct the QC meetings, perform the three phases of control except for those phases of control designated to be performed by QC Specialists, perform submittal review and approval, ensure testing is performed and provide QC certifications and documentation required in this Contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by the QC Specialists, testing laboratory personnel and any other inspection and testing personnel required by this Contract. The QC Manager is the manager of all QC activities. The QC manager is responsible for notifying the Special Inspector of activities which require their review. The QC manager is responsible for coordinating the Special Inspection activities, see paragraph QUALITY CONTROL MANAGER, in Section 01 45 35 SPECIAL INSPECTIONS.

1.5.1.2 Qualifications

A graduate of a four year accredited college or university program in one of the following disciplines: Engineering, Architecture, Construction Management, Engineering Technology, Building Construction, or Building Science, with a minimum of 10 years experience as a Project Superintendent, QC Manager, Project Manager, Project Engineer or Construction Manager on similar size and type construction contracts which included the major trades that are part of this Contract. The individual must have at least two years experience as a QC Manager. The individual must be familiar with the requirements of EM 385-1-1, and have experience in the areas of hazard identification, safety compliance, and sustainability.

1.5.2 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager must have completed the course entitled "Construction Quality Management (CQM) for Contractors." If the QC Manager does not have a current certification, they must obtain the CQM for Contractors course certification within 90 days of award. This course is periodically offered by the Naval Facilities Engineering Systems Command and the Army Corps of Engineers. Contact the Contracting Officer for information on the next scheduled class.

1.5.3 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager at the work site to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager must be the same as for the QC Manager.

1.5.4 QC Specialists Duties and Qualifications

Provide a separate QC Specialist at the work site for each of the areas of responsibilities, specified in Part 3, Execution, of the technical sections, who must assist and report to the QC Manager and who may perform production related duties but must be allowed sufficient time to perform their assigned quality control duties. QC Specialists are required to attend the Coordination and Mutual Understanding Meeting, QC meetings and be physically present at the construction site to perform the three phases of control and prepare documentation for each definable feature of work in their area of responsibility at the frequency specified below.

1.5.5 Special Inspector

The Special Inspector (SI) must be an independent third party hired directly by the Prime Contractor. The SI must not be a company employee of the Contractor or any Sub-Contractor performing the work to be inspected. The qualifications of the SI are defined in Section 01 45 35 SPECIAL INSPECTION.

1.5.6 Registered Fire Protection Engineer

The U.S. Registered Fire Protection Engineer (FPE) must be an independent third party hired directly by the Prime Contractor as an integral part of the Prime Contractor's Quality Control Organization. This FPE must have no business relationships (owner, partner, operating officer, distributor, salesman, or technical representative) with any subcontractors involved with this project, or with any fire protection equipment device manufacturers, suppliers or installers for any such equipment provided as part of this project. This FPE is responsible for review, approval, and coordination of all fire protection system material submittals, calculations, shop drawings, etc.

1.5.7 Submittal Reviewers Duties and Qualifications

Provide Submittal Reviewers, other than the QC Manager, qualified in the disciplines being reviewed, to review and certify that the submittals meet the requirements of this Contract prior to certification or approval by the QC Manager.

Each of the following submittals must be reviewed by individuals meeting the qualifications/experience specified below:

Qualification / Experience in Submittal Discipline	Submittals to be reviewed:	
	<u>Section No</u>	<u>Submittal</u>
Registered Structural engineer (SE or PE) with 10 years of concrete experience	Div 03	All
Registered Structural Engineer (SE or PE) with 10 years of structural steel experience	Div 05	All

Qualification / Experience in Submittal Discipline	Submittals to be reviewed:	
	Section No	Submittal
Roofing Manufacturer's Technical Representative / 5 years minimum	Installation and testing of roofing systems, Section 07 52 00 MODIFIED BITUMINOUS MEMBRANE ROOFING	3X during installation
Roofing Manufacturer's Technical Representative / 5 years minimum	Installation and testing of roofing systems, Section 07 41 13 METAL ROOF PANELS	3X during installation
Air Barrier Manufacturer's Technical Representative / 5 years minimum	Intallation and testing of roofing systems, Section 07 27 19.01 SELF-ADHERING AIR BARRIERS	3X during installation
Registered Fire Protection Engineer	Division 21 and 28	All Submittals
SSPC Protective coatings Specialist with 10 years of experience	09 97 13.26	All
NACE Corrosion Specialists with 10 years of experience	26 42 13.00 20	All
Registered Structural Engineer (SE or PE) with 10 years of pile driving experience	Div 31	All pile driving submittals
Registered Stuctural Engineer (SE or PE) with 10 years of concrete floating dock experience	35 51 13	All

1.5.8 Underwater QC Team

Provide Underwater QC (UWQC) Team at the work site to perform underwater surveillance and inspection for the Contractor. The UWQC Team divers must be employed by a firm having current status of Member of the Association of Diving Contractor's International (ADCI), having a minimum of five (5) years experience with underwater inspection. The parent company and individual personnel make up of the UWQC team shall comply with EM 385-1-1, OSHA and local requirements for Contract diving operations. Comply with all the applicable safety requirements of EM 385-1-1, OSHA and

local requirements for Contract diving operations.

The UWQC lead diver must be thoroughly familiar with the design plans and specifications to sufficiently understand the engineering aspects of the underwater construction and to be able to recognize and document potential problem areas associated with pile driving, cast-in-place concrete defects, and other pile defects or improperly constructed or defective areas. Provide all necessary equipment to conduct surveillance and inspection services, including diver's equipment, dive boat, communication equipment, and photographic/video equipment. Diver(s) must be equipped to maintain two-way communication with QC personnel during diving operations. Divers must maintain a separate backup communications system on site in the event of a defective primary system.

Prepare and submit a report including high quality still photographs and videos with the QC report after each dive. The report shall indicate (by grid and element) the specific areas inspected and specific description of defects, including accurate dimensional information. The QC Report shall be submitted within 24 hours of completion of the in section dive.

The frequency of underwater surveillance and inspection will be as indicated below:

ITEM	MATERIAL	INSPECTION ITEM	FREQUENCY
Mudline debris survey	Bottom conditions	Locate for removal, items that may interfere with pile driving	First inspection within 3 months of award. Follow up inspection(s) within seven days of removal of bottom debris.
Bulkhead piling	Bulkhead pipe pile and sheet pile elements	Confirm integrity of piling interlocks	Not later than seven calendar days after installation; within seven days of repair of damage
Structural, Guide and Fender Piles	Steel piling	Confirm integrity of piling, coating, and HDPE sleeve connection	Not later than seven calendar days after installation; within seven days of repair of damage. Piles may be inspected with jackets in place

The UWQC Team must be an independent third party hired directly by the Prime Contractor, and shall have no involvement with the design,

preparation of Contract, or installation of work.

1.6 QUALITY CONTROL (QC) PLAN

1.6.1 Construction Quality Control (QC) Plan

Submit a Construction QC Plan prior to start of construction.

1.6.1.1 Requirements

Provide a Construction QC Plan, prior to start of construction, that includes a table of contents, with major sections identified, with pages numbered sequentially, and that documents the proposed methods and responsibilities for accomplishing quality control during the construction of the project:

- a. QC ORGANIZATION: A chart showing the QC organizational structure.
- b. NAMES AND QUALIFICATIONS: Names and qualifications, in resume format, for each person in the QC organization. Include the CQM for Contractors course certifications for the QC Manager and Alternate QC Manager as required by the paragraphs CONSTRUCTION QUALITY MANAGEMENT TRAINING and ALTERNATE QC MANAGER DUTIES AND QUALIFICATIONS.
- c. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL: Duties, responsibilities, and authorities of each person in the QC organization.
- d. OUTSIDE ORGANIZATIONS: A listing of outside organizations, such as architectural and consulting engineering firms, that will be employed by the Contractor and a description of the services these firms will provide.
- e. APPOINTMENT LETTERS: Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager and stating that they are responsible for implementing and managing the QC program as described in this Contract. Include in this letter the responsibility of the QC Manager and Alternate QC Manager to implement and manage the three phases of control, and their authority to stop work which is not in compliance with the Contract. Letters of direction are to be issued by the QC Manager to all other QC Specialists outlining their duties, authorities, and responsibilities. Include copies of the letters in the QC Plan.
- f. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER: Procedures for reviewing, approving, and managing submittals. Provide the name(s) of the person(s) in the QC organization authorized to review and certify submittals prior to approval. Provide the initial submittal of the Submittal Register as specified in Section 01 33 00 SUBMITTAL PROCEDURES.
- g. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraphs ACCREDITATION REQUIREMENTS, as applicable.
- h. TESTING PLAN AND LOG: A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test.
- i. PROCEDURES TO COMPLETE REWORK ITEMS: Procedures to identify, record,

track, and complete rework items.

- j. LIST OF DEFINABLE FEATURES: A Definable Feature of Work (DFOW) is a task that is separate and distinct from other tasks and has control requirements and work crews unique to that task. A DFOW is identified by different trades or disciplines and is an item or activity on the construction schedule. Include in the list of DFOWs, but not be limited to, all critical path activities on the NAS. Include all activities for which this specification requires QC Specialists or specialty inspection personnel. Provide separate DFOWs in the Network Analysis Schedule for each submittal package.
- k. PROCEDURES FOR PERFORMING THE THREE PHASES OF CONTROL: Identify procedures used to ensure the three phases of control to manage the quality on this project. For each DFOW, a Preparatory and Initial phase checklist will be filled out during the Preparatory and Initial phase meetings. Conduct the Preparatory and Initial Phases and meetings with a view towards obtaining quality construction by planning ahead and identifying potential problems for each DFOW.
- l. PROCEDURES FOR COMPLETION INSPECTION: Procedures for identifying and documenting the completion inspection process. Include in these procedures the responsible party for punch out inspection, pre-final inspection, and final acceptance inspection.
- m. TRAINING PROCEDURES AND TRAINING LOG: Procedures for coordinating and documenting the training of personnel required by the Contract.
- n. ORGANIZATION AND PERSONNEL CERTIFICATIONS LOG: Procedures for coordinating, tracking and documenting all certifications on subcontractors, testing laboratories, suppliers, personnel, etc. QC Manager will ensure that certifications are current, appropriate for the work being performed, and will not lapse during any period of the contract that the work is being performed.

1.7 COORDINATION AND MUTUAL UNDERSTANDING MEETING

After submission of the QC Plan, and prior to Government approval and the start of construction, the QC Manager will meet with the Contracting Officer to present the QC program required by this Contract. When a new QC Manager is appointed, the coordination and mutual understanding meeting must be repeated.

1.7.1 Purpose

The purpose of this meeting is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, design intent, environmental requirements and procedures, coordination of activities to be performed, Special Inspections, and the coordination of the Contractor's management, production, and QC personnel. At the meeting, the Contractor will be required to explain in detail how three phases of control will be implemented for each DFOW, as well as how each DFOW will be affected by each management plan or requirement as listed below:

- a. Waste Management Plan.
- b. IAQ Management Plan.

- c. Procedures for noise and acoustics management.
- d. Environmental Protection Plan.
- e. Environmental regulatory requirements.
- f. Special Inspections.

1.7.2 Coordination of Activities

Coordinate activities included in various sections to assure efficient and orderly installation of each component. Coordinate operations included under different sections that are dependent on each other for proper installation and operation. Schedule construction operations with consideration for indoor air quality as specified in the IAQ Management Plan. Coordinate special inspections.

1.7.3 Attendees

As a minimum, the Contractor's personnel required to attend include an officer of the firm, the Project Manager, Project Superintendent, QC Manager, Alternate QC Manager, QC Specialists, Special Inspector, Environmental Manager, and subcontractor representatives. Each subcontractor who will be assigned QC responsibilities must have a principal of the firm at the meeting. Minutes of the meeting will be prepared by the QC Manager and signed by the Contractor and the Contracting Officer. Provide a copy of the signed minutes to all attendees and include in the QC Plan.

1.8 QC MEETINGS

After the start of construction, conduct weekly QC meetings by the QC Manager at the work site with the Project Superintendent, the QC Specialists, the Special Inspector, and the foremen who are performing the work of the DFOs. The QC Manager is to prepare the minutes of the meeting and provide a copy to the Contracting Officer within two working days after the meeting. The Contracting Officer may attend these meetings. As a minimum, accomplish the following at each meeting:

- a. Review the minutes of the previous meeting.
- b. Review the schedule and the status of work and rework.
- c. Review the status of submittals.
- d. Review the work to be accomplished in the next two weeks and documentation required.
- e. Resolve QC and production problems (RFI, etc.).
- f. Address items that may require revising the QC Plan.
- g. Review Accident Prevention Plan (APP).
- h. Review environmental requirements and procedures.
- i. Review Waste Management Plan.
- j. Review IAQ Management Plan.

- k. Review Environmental Management Plan.
- l. Review the status of training completion.

1.9 THREE PHASES OF CONTROL

Adequately cover both on-site and off-site work with the Three Phases of Control and include the following for each DFOW.

1.9.1 Preparatory Phase

Notify the Contracting Officer at least two work days in advance of each preparatory phase meeting. The meeting will be conducted by the QC Manager and attended by the QC Specialists, the Project Superintendent, the Special Inspector, and the foreman responsible for the DFOW. When the DFOW will be accomplished by a subcontractor, that subcontractor's foreman must attend the preparatory phase meeting. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report and in the Preparatory Phase Checklist. Perform the following prior to beginning work on each DFOW:

- a. Review each paragraph of the applicable specification sections.
- b. Review the Contract drawings.
- c. Verify that field measurements are as indicated on construction and/or shop drawings before confirming product orders, in order to minimize waste due to excessive materials.
- d. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required.
- e. Review the testing plan and ensure that provisions have been made to provide the required QC testing.
- f. Review special inspections required by Section 01 45 35 SPECIAL INSPECTION, the statement of special inspections and the schedule of special inspections.
- g. Examine the work area to ensure that the required preliminary work has been completed.
- h. Coordinate the schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- i. Arrange for the return of shipping/packaging materials, such as wood pallets, where economically feasible.
- j. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data and are properly stored.
- k. Discuss specific controls used and construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFOW.

1. Review the APP and appropriate Activity Hazard Analysis (AHA) to ensure that applicable safety requirements are met, and that required Safety Data Sheets (SDS) are submitted.

1.9.2 Initial Phase

Notify the Contracting Officer at least two work days in advance of each initial phase. When construction crews are ready to start work on a DFOW, conduct the initial phase with the QC Specialists, the Project Superintendent, the Special Inspector, and the foreman responsible for that DFOW. Observe the initial segment of the DFOW to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily CQC Report and in the Initial Phase Checklist. Repeat the initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. Perform the following for each DFOW:

- a. Establish level of workmanship and verify that it meets the minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
- b. Resolve any workmanship issues.
- c. Ensure that testing is performed by the approved laboratory.
- d. Check work procedures for compliance with the APP and the appropriate AHA to ensure that applicable safety requirements are met.
- e. Review project specific work plans (i.e. Cx, HAZMAT Abatement, Stormwater Management) to ensure all preparatory work items have been completed and documented.
- f. Coordinate scheduled work with special inspections required by Section 01 45 35 SPECIAL INSPECTIONS, the statement of special inspections and the schedule of special inspections.

1.9.3 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary, until the completion of each DFOW and document in the daily CQC Report:

- a. Ensure the work is in compliance with Contract requirements.
- b. Maintain the quality of workmanship required.
- c. Ensure that testing is performed by the approved laboratory.
- d. Ensure that rework items are being corrected.
- e. Assure manufacturers representatives have performed necessary inspections if required and perform safety inspections.
- f. Coordinate scheduled work with special inspections required by Section 01 45 35 SPECIAL INSPECTIONS, the statement of special inspections and the schedule of special inspections.

1.9.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same DFOW if the quality of on-going work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a DFOW is resumed after substantial period of inactivity, or if other problems develop.

1.9.5 Notification of Three Phases of Control for Off-Site Work

Notify the Contracting Officer at least two weeks prior to the start of the preparatory and initial phases.

1.10 SUBMITTAL REVIEW AND APPROVAL

Procedures for submission, review and approval of submittals are described in Section 01 33 00 SUBMITTAL PROCEDURES.

1.11 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this Contract.

1.11.1 Accreditation Requirements

Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (E 329, C 1077, D 3666, D 3740, E 543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing must meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the Corporate Office.

1.11.2 Laboratory Accreditation Authorities

Laboratory Accreditation Authorities include the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology at <https://www.nist.gov/nvlap>, the American Association of State Highway and Transportation Officials (AASHTO) Accreditation Program at <http://www.aashtoresource.org/aap/overview>, International Accreditation Services, Inc. (IAS) at <http://www.iasonline.org>, U.S. Army Corps of Engineers Materials Testing Center (MTC) at <http://www.erdc.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/9254/Article/476661/materials-testing-center.aspx>, the American Association for Laboratory Accreditation (A2LA) program at <http://www.a2la.org/>, the Washington Association of Building Officials (WABO) at <http://www.wabo.org/> (Approval authority for WABO is limited to projects within Washington State), and the Washington Area Council of Engineering Laboratories (WACEL) at <https://www.wacel.org/lab-accreditation-and-inspection-agency-audit-programs/laboratory-accreditation-program/> (Approval authority by WACEL is limited to projects within Facilities Engineering Command (FEC) Washington geographical area).

1.11.3 Capability Check

The Contracting Officer retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract.

1.11.4 Test Results

Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify the Contracting Officer immediately. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results must be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the Contracting Officer via the QC Manager. Furnish a summary report of field tests at the end of each month, in accordance with paragraph INFORMATION FOR THE CONTRACTING OFFICER.

1.11.5 Test Reports and Monthly Summary Report of Tests

Furnish the signed reports, certifications, and a summary report of field tests at the end of each month to the Contracting Officer. Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month. Provide a copy of the signed test reports and certifications to the OMSI preparer for inclusion into the OMSI documentation, in accordance with Sections 01 78 23 OPERATION AND MAINTENANCE DATA and 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI).

1.12 QC CERTIFICATIONS

1.12.1 CQC Report Certification

Contain the following statement within the CQC Report: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge, except as noted in this report."

1.12.2 Invoice Certification

Furnish a certificate to the Contracting Officer with each payment request, signed by the QC Manager, attesting that as-built drawings are current, coordinated and attesting that the work for which payment is requested, including stored material, is in compliance with Contract requirements.

1.12.3 Completion Certification

Upon completion of work under this Contract, the QC Manager must furnish a certificate to the Contracting Officer attesting that "the work has been completed, inspected, tested and is in compliance with the Contract." Provide a copy of this final QC Certification for completion to the preparer of the Operation & Maintenance (O&M) documentation.

1.13 COMPLETION INSPECTIONS

1.13.1 Punch-Out Inspection

Near the completion of all work or any increment thereof, established by a completion time stated in the Contract Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the QC Manager must conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings, specifications and Contract. Include in the punch list any remaining items on the "Rework Items List", which were not corrected prior to the Punch-Out Inspection. Include within the punch list the estimated date by which the deficiencies will be corrected. Provide a copy of the punch list to the Contracting Officer. The QC Manager, or staff, must make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government "Pre-Final Inspection".

1.13.2 Pre-Final Inspection

The Government and QC Manager will perform this inspection to verify that the facility is complete and ready to be occupied. A Government "Pre-Final Punch List" will be documented by the QC Manager as a result of this inspection. The QC Manager will ensure that all items on this list are corrected prior to notifying the Government that a "Final" inspection with the Client can be scheduled. Any items noted on the "Pre-Final" inspection must be corrected in a timely manner and be accomplished before the contract completion date for the work, or any particular increment thereof, if the project is divided into increments by separate completion dates.

1.13.3 Final Acceptance Inspection

Notify the Contracting Officer at least 14 calendar days prior to the date a final acceptance inspection can be held. State within the notice that all items previously identified on the pre-final punch list will be corrected and acceptable, along with any other unfinished Contract work, by the date of the final acceptance inspection. The Contractor must be represented by the QC Manager, the Project Superintendent and others deemed necessary. Attendees for the Government will include the Contracting Officer, other FEAD/ROICC personnel, and personnel representing the Client. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction."

1.14 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities.

1.14.1 Construction Documentation

Reports are required for each day that work is performed and must be attached to the Contractor Quality Control Report prepared for the same day. Maintain current and complete records of on-site and off-site QC program operations and activities. The forms identified under the paragraph "INFORMATION FOR THE CONTRACTING OFFICER" will be used. Reports

are required for each day work is performed. Account for each calendar day throughout the life of the Contract. Every space on the forms must be filled in. Use N/A if nothing can be reported in one of the spaces. The Project Superintendent and the QC Manager must prepare and sign the Contractor Production and CQC Reports, respectively. The reporting of work must be identified by terminology consistent with the construction schedule. In the "remarks" sections of the reports, enter pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site, quality control problem areas, deviations from the QC Plan, construction deficiencies encountered, meetings held. For each entry in the report(s), identify the Schedule Activity No. that is associated with the entered remark.

1.14.2 Quality Control Validation

Establish and maintain the following in an electronic folder. Divide folder into a series of tabbed sections as shown below. Ensure folder is updated at each required progress meeting.

- a. All completed Preparatory and Initial Phase Checklists, arranged by specification section.
- b. All milestone inspections, arranged by Activity Number.
- c. An up-to-date copy of the Testing Plan and Log with supporting field test reports, arranged by specification section.
- d. Copies of all contract modifications, arranged in numerical order. Also include documentation that modified work was accomplished.
- e. An up-to-date copy of the Rework Items List.
- f. Maintain up-to-date copies of all punch lists issued by the QC staff to the Contractor and Sub-Contractors and all punch lists issued by the Government.
- g. Special inspection reports.

1.14.3 Reports from the QC Specialist(s)

Reports are required for each day that work is performed in their area of responsibility. QC Specialist reports must include the same documentation requirements as the CQC Report for their area of responsibility. QC Specialist reports are to be prepared, signed and dated by the QC Specialists and must be attached to the CQC Report prepared for the same day.

1.14.4 Testing Plan and Log

As tests are performed, the QC Manager will record on the "Testing Plan and Log" the date the test was performed and the date the test results were forwarded to the Contracting Officer. Attach a copy of the updated "Testing Plan and Log" to the last daily CQC Report of each month, per the paragraph "INFORMATION FOR THE CONTRACTING OFFICER". Provide a copy of the final "Testing Plan and Log" to the preparer of the Operation & Maintenance (O&M) documentation.

1.14.5 Rework Items List

The QC Manager must maintain a list of work that does not comply with the Contract, identifying what items need to be reworked, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. Attach a copy of the "Rework Items List" to the last daily CQC Report of each month. The Contractor is responsible for including those items identified by the Contracting Officer.

1.14.6 As-Built Drawings

The QC Manager is required to ensure the as-built drawings, required by Section 01 78 00 CLOSEOUT SUBMITTALS are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g. PC No., Modification No., Request for Information No., etc.). The QC Manager or QC Specialist assigned to an area of responsibility must initial each revision. Upon completion of work, the QC Manager will furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the Contracting Officer.

1.15 NOTIFICATION ON NON-COMPLIANCE

The Contracting Officer will notify the Contractor of any detected non-compliance with the Contract. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, is deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time for excess costs or damages by the Contractor.

1.16 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

Submit an IAQ Management Plan within 15 calendar days after Contract award and not less than 10 calendar days before the preconstruction meeting. Revise and resubmit Plan as required by the Contracting Officer. Make copies of the final plan available to all workers on site. Include provisions in the Plan to meet the requirements specified below and to ensure safe, healthy air for construction workers and building occupants. Submit Final IAQ Management Plan for inclusion in the Sustainability eNotebook, in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

1.16.1 Requirements During Construction

Provide for evaluation of indoor Carbon Dioxide concentrations in accordance with ASTM D6245. Provide for evaluation of volatile organic compounds (VOCs) in indoor air in accordance with ASTM D6345. Use filters with a Minimum Efficiency Reporting Value (MERV) of 8 in permanently installed air handlers during construction.

1.16.1.1 Control Measures

Meet or exceed the requirements of ANSI/SMACNA 008, Chapter 3, to help

minimize contamination of the building from construction activities. The five requirements of this manual which must be adhered to are described below:

- a. HVAC protection: Isolate return side of HVAC system from surrounding environment to prevent construction dust and debris from entering the duct work and spaces.
- b. Source control: Use low emitting paints and other finishes, sealants, adhesives, and other materials as specified. When available, cleaning products must have a low VOC content and be non-toxic to minimize building contamination. Utilize cleaning techniques that minimize dust generation. Cycle equipment off when not needed. Prohibit idling motor vehicles where emissions could be drawn into building. Designate receiving/storage areas for incoming material that minimize IAQ impacts.
- c. Pathway interruption: When pollutants are generated use strategies such as 100 percent outside air ventilation or erection of physical barriers between work and non-work areas to prevent contamination.
- d. Housekeeping: Clean frequently to remove construction dust and debris. Promptly clean up spills. Remove accumulated water and keep work areas dry to discourage the growth of mold and bacteria. Take extra measures when hazardous materials are involved.
- e. Scheduling: Control the sequence of construction to minimize the absorption of VOCs by other building materials.

1.16.1.2 Moisture Contamination

- a. Remove accumulated water and keep work dry.
- b. Use dehumidification to remove moist, humid air from a work area.
- c. Do not use combustion heaters or generators inside the building.
- d. Protect porous materials from exposure to moisture.
- e. Remove and replace items which remain damp for more than a few hours.

1.16.2 Requirements after Construction

After construction ends and prior to occupancy, conduct a building flush-out or test the indoor air contaminant levels. Flush-out must be a minimum two-weeks with MERV-13 filtration media as determined by ASHRAE 52.2 at 100 percent outside air. Air contamination testing must be consistent with EPA's current Compendium of Methods for the Determination of Air Pollutants in Indoor Air. After building flush-out or testing and prior to occupancy, replace filtration media. Filtration media must have a MERV of 13 as determined by ASHRAE 52.2.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PREPARATION

Designate receiving/storage areas for incoming material to be delivered according to installation schedule and to be placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. Store and handle materials in a manner as to prevent loss from weather and other damage. Keep materials, products, and accessories covered and off the ground, and store in a dry, secure area. Prevent contact with material that may cause corrosion, discoloration, or staining. Protect all materials and installations from damage by the activities of other trades.

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SECTION 01 45 35

SPECIAL INSPECTIONS

11/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16 (2017; Errata 2018; Supp 1 2018) Minimum
Design Loads and Associated Criteria for
Buildings and Other Structures

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

1.2 GENERAL REQUIREMENTS

Perform Special Inspections in accordance with the Statement of Special Inspections, Schedule of Special Inspections and Chapter 17 of ICC IBC. The Statement of Special Inspections and Schedule of Special Inspections are included as an attachment to this specification. Special Inspections are to be performed by an independent third party and are intended to ensure that the work of the Prime Contractor is in accordance with the Contract Documents and applicable building codes. Special inspections do not take the place of the three phases of control inspections performed by the Contractor's QC Manager or any testing and inspections required by other sections of the specifications.

1.3 DEFINITIONS

1.3.1 Continuous Special Inspections

Continuous Special Inspections is the constant monitoring of specific tasks by a special inspector. These inspections must be carried out continuously over the duration of the particular tasks.

1.3.2 Perform

Perform these Special Inspections tasks for each welded joint or member.

1.3.3 Observe

Observe these Special Inspections items on a periodic daily basis. Operations need not be delayed pending these inspections.

1.3.4 Special Inspector (SI)

A qualified person retained by the Contractor and approved by the Contracting Officer as having the competence necessary to inspect a particular type of construction requiring Special Inspections. The SI

must be an independent third party hired directly by the Prime Contractor.

1.3.5 Associate Special Inspector (ASI)

A qualified person who assists the SI in performing Special Inspections but must perform inspection under the direct supervision of the SI and cannot perform inspections without the SI on site.

1.3.6 Third Party

A Special inspector must not be an employee of the Contractor or of any Sub-Contractor performing the work to be inspected.

1.3.7 Contracting Officer

The Government official having overall authority for administrative contracting actions. Certain contracting actions may be delegated to the Contracting Officer's Representative (COR).

1.3.8 Contractor's Quality Control (QC) Manager

An individual retained by the Prime Contractor and qualified in accordance with the Section 01 45 00.00 10 QUALITY CONTROL 01 45 00.00 20 QUALITY CONTROL 01 45 00.00 40 QUALITY CONTROL having the overall responsibility for the Contractor's QC organization.

1.3.9 Structural Engineer of Record (SER)

A registered design professional contracted by the Government as an A/E responsible for the overall design and review of submittal documents prepared by others. The SER is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws in the state in which the design professional works. The SER is also referred to as the Engineer of Record (EOR) in design code documents.

1.3.10 Statement of Special Inspections (SSI)

A document developed by the SER identifying the material, systems, components and work required to have Special Inspections. This statement is included at the end of this specification.

1.3.11 Schedule of Special Inspections (SSI)

A schedule which lists each of the required Special Inspections, the extent to which each Special Inspection is to be performed, and the required frequency for each in accordance with ICC IBC Chapter 17. This schedule is included at the end of this specification.

1.3.12 Designated Seismic Systems (DSS)

Those nonstructural components that require design in accordance with ASCE 7-16 Chapter 13 and for which the component importance factor, I_p , is greater than 1.0. This designation applies to systems that are required to be operational following the Design Earthquake for RC I - IV structures and following the MCER for RC V structures. All systems in RC V facilities designated as MC-1 in accordance with UFC 3-301-02 are considered part of the Designated Seismic Systems. Designated Seismic Systems will have an Importance Factor $I_p = 1.5$.

1.3.13 Definable Feature of Work (DFOW)

An inspection group that is separate and distinct from other inspection groups, having inspection requirements or inspectors that are unique.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

SD-06 Test Reports

Special Inspections Daily Reports

Special Inspections Biweekly Reports

SD-07 Certificates

AISC Certified Steel Fabricator

Steel Joist Institute Membership

Certificate of Compliance

Special Inspector Qualifications; G

SD-11 Closeout Submittals

Interim Report of Special Inspections for Each DFOW; G

Comprehensive Final Report of Special Inspections; G

1.5 SPECIAL INSPECTOR QUALIFICATIONS

Submit qualifications for each special inspector.

1.5.1 Steel Construction and High Strength Bolting

1.5.1.1 Special Inspector

- a. ICC Structural Steel and Bolting Special Inspector certificate with one year of related experience, or
- b. Registered Professional Engineer with three years of related experience

1.5.1.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.2 Welding Structural Steel

1.5.2.1 Special Inspector

- a. ICC Structural Welding Special Inspector certificate with one year of

related experience, or

- b. AWS Certified Welding Inspector

1.5.2.2 Associate Special Inspector

AWS Certified Associate Welding Inspector

1.5.3 Nondestructive Testing of Welds

1.5.3.1 Special Inspector

NDT Level III Certificate

1.5.3.2 Associate Special Inspector

NDT Level II Certificate plus one year of related experience

1.5.4 Cold Formed Steel Framing

1.5.4.1 Special Inspector

- a. ICC Structural Steel and Bolting Special Inspector certificate with one year of related experience, or
- b. ICC Commercial Building Inspector with one year of experience, or
- c. ICC Residential Building Inspector with one year of experience, or
- d. Registered Professional Engineer with three years related experience

1.5.4.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.5 Concrete Construction

1.5.5.1 Special Inspector

- a. ICC Reinforced Concrete Special Inspector Certificate with one year of related experience, or
- b. ACI Concrete Construction Special Inspector, or
- c. Registered Professional Engineer with three years of related experience

1.5.5.2 Associate Special Inspector

- a. ACI Concrete Construction Special Inspector in Training, or
- b. Engineer-In-Training with one year of related experience

1.5.6 Prestressed Concrete Construction

1.5.6.1 Special Inspector

- a. ICC Pre-stressed Special Inspector Certificate with one year of related experience, or

- b. PCI Quality Control Technician/ Inspector Level II Certificate with one year of related experience, or
- c. Registered Professional Engineer with three years of related experience

1.5.6.2 Associate Special Inspector

- a. PCI Quality Control Technician/ Inspector Level I Certificate with one year of related experience, or
- b. Engineer-In-Training with one year of related experience

1.5.7 Masonry Construction

1.5.7.1 Special Inspector

- a. ICC Structural Masonry Special Inspector Certificate with one year of related experience, or
- b. Registered Professional Engineer with three years of related experience

1.5.7.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.8 Verification of Site Soil Condition, Fill Placement and Load-Bearing Requirements

1.5.8.1 Special Inspector

- a. ICC Soils Special Inspector Certificate with one year of related experience, or
- b. NICET Soils Technician Level II Certificate in Construction Material Testing, or
- c. Geologist-In-Training with three years of related experience, or
- d. Registered Professional Engineer with three years of related experience

1.5.8.2 Associate Special Inspector

- a. NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or
- b. Engineer-In-Training with one year of related experience

1.5.9 Deep Foundations

1.5.9.1 Special Inspector

- a. NICET Soils Technician Level II Certificate in Construction Material Testing, or
- b. Geologist-In-Training with three years of related experience, or
- c. Registered Professional Engineer with three years of related experience

1.5.9.2 Associate Special Inspector

- a. NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or
- b. NICET Geotechnical Engineering Technician Level I Construction or Generalist Certificate with one year of related experience, or
- c. Engineer-In-Training with one year of related experience

1.5.10 Fire-Resistant Penetrations and Joints

1.5.10.1 Special Inspector

- a. Passed the UL Firestop Exam with one year of related experience, or
- b. Passed the FM Firestop Exam with one year of related experience, or
- c. Registered Professional Engineer with related experience

PART 2 PRODUCTS

2.1 FABRICATOR SPECIAL INSPECTIONS

Special Inspections of fabricator's work performed in the fabricator's shop is required to be inspected in accordance with the Statement of Special Inspections and the Schedule of Special Inspections unless the fabricator is certified by the approved agency to perform such work without Special Inspections. Submit the following certifications to the Contracting Officer for information to allow work performed in the fabricator's shop to not be subjected to Special Inspections.

AISC Certified Steel Fabricator.

Steel Joist Institute Membership

Precast Concrete Institute (PCI) Certified Plant, Group C

At the completion of fabrication, submit a certificate of compliance, to be included with the comprehensive final report of Special Inspections, stating that the materials supplied and work performed by the fabricator are in accordance with the construction documents.

PART 3 EXECUTION

3.1 RESPONSIBILITIES

3.1.1 Quality Control Manager

- a. Supervise all Special Inspectors required by the Contract Documents and the IBC.
- b. Verify the qualifications of all of the Special Inspectors.
- c. Verify the qualifications of fabricators.
- d. Maintain a 3-ring binder for the Special Inspector's daily and biweekly reports. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer

and the SER.

- e. Maintain a rework items list that includes discrepancies noted on the Special Inspectors daily report.

3.1.2 Special Inspectors

- a. Inspect all elements of the project for which the special inspector is qualified to inspect and are identified in the Schedule of Special Inspections.
- b. Attend preparatory phase meetings related to the Definable Feature of Work (DFOW) for which the special inspector is qualified to inspect.
- c. Submit Special Inspections agency's written NDT practices for the monitoring and control of the agency's operations to include the following:
 - (1) The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel.
 - (2) The agency's inspection procedures, including general inspection, material controls, and visual welding inspection.
- d. Submit qualification records for nondestructive testing (NDT) technicians designated for the project.
- e. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.
- f. Submit a copy of the daily reports to the QC Manager.
- g. Report discrepancies that are observed during Special Inspections to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report.
- h. Submit a biweekly Special Inspection Report until all inspections are complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following:
 - (1) A brief summary of the work performed during the reporting time frame.
 - (2) Changes and discrepancies with the drawings, specifications and mechanical or electrical component certification, that were observed during the reporting period.
 - (3) Discrepancies which were resolved or corrected.
 - (4) A list of nonconforming items requiring resolution.
 - (5) All applicable test result including nondestructive testing reports.
- i. At the completion of each DFOW requiring Special Inspections, submit an interim report of Special Inspections that documents the Special

Inspections completed for that DFOV. Identify the inspector responsible for each item inspected and corrections of all discrepancies noted in the daily reports. The interim report of Special Inspections must be signed, dated and indicate the certification of the special inspector qualifying them to conduct the inspection.

- j. At the completion of the project submit a comprehensive final report of Special Inspections that documents the Special Inspections completed for the project and corrections of all discrepancies noted in the daily reports. The comprehensive final report of Special Inspections must be signed, dated and indicate the certification of the special inspector qualifying them to conduct the inspection.

3.2 DEFECTIVE WORK

Check work as it progresses, but failure to detect any defective work or materials must in no way prevent later rejection if defective work or materials are discovered, nor obligate the Contracting Officer to accept such work.

-- End of Section --

Project: NOAA OMAO Ship & Support Facility Relocation
 Location: Newport, RI
 Project #: 1562331
 Date: 6/10/2021



STATEMENT OF SPECIAL INSPECTIONS

Project Seismic Design Category: **B**
 Project Risk Category: **II**
 Project Design Wind Speed (mph): **130**
 Number of Stories: **2**
 Structure Height Above Grade (ft): **40**
 Hazardous Occupancy or attached to such? **No** Group H Occupancies

Special Inspector of Record (SIOR)

A Special Inspector of Record (SIOR) IS NOT required (per UFGS 01 45 35, Section 1.3.8)

Lateral Force Resisting System (LFRS)

2018 IBC 1704.3.2 and 1704.3.3

Following is a listing of critical main wind/seismic force resisting systems for this structure. Carefully inspect these elements as part of the roles and responsibilities of the Special Inspector (reference the Schedule of Special Inspections for inspection checklists).

Vertical LFRS Elements	Notes
Ordinary Concentric Braced Frames	Warehouse along clerestory window line
Concrete Grade Beams Resisting Lateral Loads	
Ordinary Reinforced Masonry Shear Walls	
Horizontal LFRS Elements	Notes
Collector Elements	Identified on plan with key notes
Concrete over metal deck	2nd floor
Metal Roof Deck & Related Fastening System	
Out of Plane Wall Connections	
Diaphragm Bracing	
Cast in Place Concrete Floor and Roof Diaphragms	

Project: NOAA OMAO Ship & Support Facility Relocation
Location: Newport, RI
Project #: 1562331
Date: 6/10/2021

Designated Seismic Systems (DSS)

(2018 IBC 1705.13.3) (ASCE 7-16, 13.2.2, C13.2.2) (UFC 3-301-1, 2-5.3)

DESIGNATED SEISMIC SYSTEMS DO NOT APPLY TO THIS PROJECT, due to the Seismic Design Category being less than C.

ELECTRICAL Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

N/A

N/A

N/A

N/A

N/A

If additional space is required, append an additional sheet listing the remaining DSS

MECHANICAL/PLUMBING Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

N/A

N/A

N/A

N/A

N/A

N/A

If additional space is required, append an additional sheet listing the remaining DSS

OTHER Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

N/A

N/A

N/A

N/A

N/A

N/A

Final Walk Down Inspection and Report

(UFC 3 301 01 SECTION 2-5.4)

Final Walk Down Inspection of non-structural Designated Seismic Systems does not apply to this project (no Designated Seismic Systems)

SCHEDULE OF SPECIAL INSPECTIONS

Reference UFGS 01 45 35 for all requirements not noted as part of this schedule.

INSPECTION DEFINITIONS:

- PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and noted verification.
- OBSERVE:** Observe these items randomly during the course of each work day to insure that applicable requirements are being met. Operations need not be delayed pending these inspections at contractor's risk.
- DOCUMENT:** Document, with a report, that the work has been performed in accordance with the contract documents. This is in addition to any other reports required in the Special Inspections guide specification.
- CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

The Seismic Design Category for this project is: ☐ A, ☒ B, ☐ C, ☐ D, ☐ E, ☐ F (check appropriate box)

STRUCTURAL - STEEL – WELDING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

STEEL INSPECTION <u>PRIOR TO WELDING</u> – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-1		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Verify that the welding procedures specification (WPS) is available	PERFORM	
2. Verify manufacturer certifications for welding consumables are available	PERFORM	
3. Verify material identification	PERFORM	Type and grade.
4. Welder Identification System	PERFORM	The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.
5. Fit-up of groove welds (including joint geometry)	OBSERVE	<ul style="list-style-type: none"> ✓ Joint preparation ✓ Dimensions (alignment, root opening, root face, bevel) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location) ✓ Backing type and fit (if applicable)
6. Configuration and finish of access holes	OBSERVE	
7. Fit-up of fillet welds	OBSERVE	<ul style="list-style-type: none"> ✓ Dimensions (alignment, gaps at root) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location)
STEEL INSPECTION <u>DURING WELDING</u> – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-2		
TASK	INSPECTION TYPE	DESCRIPTION
8. Use of qualified welders	PERFORM	Welding by welders, welding operators, and tack welders who are qualified in conformance with requirements.
9. Control and handling of welding consumables	OBSERVE	<ul style="list-style-type: none"> ✓ Packaging ✓ Electrode atmospheric exposure control
10. No welding over cracked tack welds	OBSERVE	
11. Environmental conditions	OBSERVE	<ul style="list-style-type: none"> ✓ Wind speed within limits ✓ Precipitation and temperature
12. Welding Procedures Specification followed	OBSERVE	<ul style="list-style-type: none"> ✓ Settings on welding equipment ✓ Travel speed ✓ Selected welding materials ✓ Shielding gas type/flow rate ✓ Preheat applied ✓ Interpass temperature maintained (min./max.) ✓ Proper position (F, V, H, OH) ✓ Intermix of filler metals avoided
13. Welding techniques	OBSERVE	<ul style="list-style-type: none"> ✓ Interpass and final cleaning ✓ Each pass within profile limitations ✓ Each pass meets quality requirements

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - STEEL – WELDING SECTION (CONTINUED)

STEEL INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-3		
TASK	INSPECTION TYPE ¹	DESCRIPTION
14. Welds cleaned	OBSERVE	
15. Size, length, and location of all welds	PERFORM	Size, length, and location of all welds conform to the requirements of the detail drawings.
16. Welds meet visual acceptance criteria	PERFORM AND DOCUMENT	<ul style="list-style-type: none"> ✓ Crack prohibition ✓ Weld/base-metal fusion ✓ Crater cross section ✓ Weld profiles ✓ Weld size ✓ Undercut ✓ Porosity
17. Arc strikes	PERFORM	
18. k-area	PERFORM	When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks.
19. Backing removed, weld tabs removed and finished, and fillet welds added where required	PERFORM	
20. Repair activities	PERFORM AND DOCUMENT	
21. Document acceptance or rejection of welded joint or member	PERFORM	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL – BOLTING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

STEEL INSPECTION TASKS PRIOR TO BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-1		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Manufacture's certifications available for fastener materials	PERFORM	
2. Fasteners marked in accordance with ASTM requirements	OBSERVE	
3. Proper fasteners selected for joint detail (grade, type, bolt length if threads are to be excluded from shear plane)	OBSERVE	
4. Proper bolting procedure selected for joint detail	OBSERVE	
5. Connecting elements, including appropriate faying surface condition and hole preparation, if specified, meet applicable requirements	OBSERVE	
6. Proper storage provided for bolts, nuts, washers, and other fastener components	OBSERVE	
STEEL INSPECTION TASKS DURING BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-2		
TASK	INSPECTION TYPE ¹	DESCRIPTION
7. Fastener assemblies of suitable condition, placed in all holes and washers (if required) are positioned as required	OBSERVE	
8. Joint brought to the snug-tight condition prior to pretensioning operation	OBSERVE	
9. Fastener component not turned by the wrench prevented from rotating	OBSERVE	
10. Bolts are pretensioned in accordance with RCSC Specification, progressing systematically from the most rigid point toward the free edges	OBSERVE	
STEEL INSPECTION TASKS AFTER BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.1, AISC 360-10: Table C-N5.6-3		
TASK	INSPECTION TYPE ¹	DESCRIPTION
11. Document acceptance or rejection of all bolted connections	DOCUMENT	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL - NON DESTRUCTIVE TESTING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Section N5.5		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Use of qualified nondestructive testing personnel	PERFORM	Visual weld inspection and nondestructive testing (NDT) shall be conducted by personnel qualified in accordance with AWS D1.8 clause 7.2
2. CJP groove welds	OBSERVE	Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 20% of CJP groove welds for materials greater than 5/16" (8mm) thick. Testing rate must be increased to 100% if greater than 5% of welds tested have unacceptable defects.
3. Welded joints subject to fatigue	OBSERVE	Dye penetrant testing (DT) and Ultrasonic testing (UT) shall be performed on 100% of welded joints identified on contract drawings as being subject to fatigue.
4. Weld tab removal sites	OBSERVE	At the end of welds where weld tabs have been removed, magnetic particle testing shall be performed on the same beam-to-column joints receiving UT

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - STEEL – AISC 341 REQUIREMENTS (SEISMIC PROVISIONS) SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐**

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Section J6.2		
TASK	INSPECTION TYPE ¹	DESCRIPTION
5. CJP groove welds	OBSERVE	Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 100% of CJP groove welds for materials greater than 5/16" thick (8mm).
6. Beam cope and access hole.	OBSERVE	At welded splices and connections, thermally cut surfaces of beam copes and access holes shall be tested using magnetic particle testing (MT) or dye penetrant testing (DT), when the flange thickness exceeds 1 1/2 in. for rolled shapes, or when the web thickness exceeds 1 1/2 in. for built-up shapes.
7. K-area NDT (AISC 341)	PERFORM	Where welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, the web shall be tested for cracks using magnetic particle testing (MT). The MT inspection area shall include the k-area base metal within 3-inches of the weld. The MT shall be performed no sooner than 48 hours following completion of the welding.
8. Placement of reinforcing or contouring fillet welds	DOCUMENT	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL - COMPOSITE CONSTRUCTION ¹**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

COMPOSITE CONSTRUCTION PRIOR TO PLACING CONCRETE – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table N6.1, AISC 341-16: Table J9.1		
TASK	INSPECTION TYPE ²	DESCRIPTION
1. Placement and installation of steel headed stud anchors	PERFORM	
2. Material identification of reinforcing steel (Type/Grade)	OBSERVE	
3. Determination of carbon equivalent for reinforcing steel other than ASTM A706	OBSERVE	
4. Proper reinforcing steel size, spacing, clearances, support, and orientation	OBSERVE	
5. Reinforcing steel has not been re-bent in the field	OBSERVE	
6. Reinforcing clearances have been provided	OBSERVE	
7. Reinforcing steel has been tied and supported as required	OBSERVE	
8. Composite member has required size	OBSERVE	

END SECTION**STRUCTURAL - STEEL - OTHER INSPECTIONS****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

OTHER STEEL INSPECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Tables J8.1 & J10.1		
TASK	INSPECTION TYPE ²	DESCRIPTION
1. Anchor rods and other embedments supporting structural steel	PERFORM	Verify the diameter, grade, type, and length of the anchor rod or embedded item, and the extent or depth of embedment prior to placement of concrete.
2. Fabricated steel or erected steel frame	OBSERVE	Verify compliance with the details shown on the construction documents, such as braces, stiffeners, member locations and proper application of joint details at each connection.
3. Reduced beam sections (RBS) where/if occurs	DOCUMENT	✓ Contour and finish ✓ Dimensional tolerances
4. Protected zones	DOCUMENT	No holes or unapproved attachments made by fabricator or erector
5. H-piles where/if occurs	DOCUMENT	No holes or unapproved attachments made by the responsible contractor

END SECTION¹ See Concrete Construction Section for all concrete related inspection of composite steel construction.

² **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK - PLACEMENT SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

METAL DECK INSPECTION <u>PRIOR TO</u> DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.1		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness	PERFORM	
2. Document acceptance or rejection of deck and deck accessories	DOCUMENT	
METAL DECK INSPECTION <u>DURING</u> DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.2		
TASK	INSPECTION TYPE ¹	DESCRIPTION
3. Verify compliance of deck and all deck accessories installation with construction documents	PERFORM	
4. Verify deck materials are represented by the mill certifications that comply with the construction documents	PERFORM	
5. Document acceptance or rejection of installation of deck and deck accessories	DOCUMENT	
METAL DECK INSPECTION <u>AFTER</u> DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.3		
TASK	INSPECTION TYPE ¹	DESCRIPTION
6. Welding procedure specification (WPS) available	PERFORM	
7. Manufactures certifications for welding consumables available	OBSERVE	
8. Material identification (type/grade)	OBSERVE	
9. Check welding equipment	OBSERVE	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK – WELDING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

METAL DECK INSPECTION <u>DURING</u> WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.4		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Use of qualified welders	OBSERVE	
2. Control and handling of welding consumables	OBSERVE	
3. Environmental conditions (wind speed, moisture, temperature)	OBSERVE	
4. WPS followed	OBSERVE	
METAL DECK INSPECTION <u>AFTER</u> WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.5		
TASK	INSPECTION TYPE ¹	DESCRIPTION
5. Verify size and location of welds, including support, sidelap, and perimeter welds.	PERFORM	
6. Welds meet visual acceptance criteria	PERFORM	
7. Verify repair activities	PERFORM	
8. Document acceptance or rejection of welds	DOCUMENT	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK – FASTENING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

METAL DECK INSPECTION <u>BEFORE</u> MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.6		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Manufacturer installation instructions available for mechanical fasteners	OBSERVE	
2. Proper tools available for fastener installation	OBSERVE	
METAL DECK INSPECTION <u>DURING</u> MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.7		
TASK	INSPECTION TYPE ¹	DESCRIPTION
3. Fasteners are positioned as required	OBSERVE	
4. Fasteners are installed in accordance with manufacturer's instructions	OBSERVE	
METAL DECK INSPECTION <u>AFTER</u> MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.8		
TASK	INSPECTION TYPE ¹	DESCRIPTION
5. Check spacing, type, and installation of support fasteners	PERFORM	
6. Check spacing, type, and installation of sidelap fasteners	PERFORM	
7. Check spacing, type, and installation of perimeter fasteners	PERFORM	
8. Verify repair activities	PERFORM	
9. Document acceptance or rejection of mechanical fasteners	DOCUMENT	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - LIGHT GAUGE STEEL FRAMING AND/OR LIGHT GAUGE TRUSSES SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

LIGHT GAUGE STEEL CONSTRUCTION AND CONNECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.2, 1705.11.2, 1705.11.3, UFC 4 023 03		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Trusses spanning 60-feet or greater where/if applies	PERFORM	Verify that temporary and permanent truss restraint/bracing is installed in accordance with approved truss submittal package.
2. Welded connections (seismic and/or wind resisting system)	OBSERVE	Visually inspect all welds composing part of the main wind or seismic force resisting system, including shearwalls, braces, collectors (drag struts), and hold-downs.
3. Connections (seismic and/or wind resisting system)	OBSERVE	Visually inspect all screw attachment, bolting, anchoring and other fastening of components within the main wind or seismic force resisting system, including roof deck, roof framing, exterior wall covering, wall to roof/floor connections, braces, collectors (drag struts) and hold-downs.
4. Cold-formed steel (progressive collapse resisting system where/if applies)	OBSERVE	Verify proper welding operations, screw attachment, bolting, anchoring and other fastening of components within the progressive collapse resisting system, including horizontal tie force elements, vertical tie force elements and bridging elements (UFC 4 023 03).

END SECTION**STRUCTURAL - OPEN-WEB STEEL JOISTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☒

OPEN-WEB STEEL JOISTS AND JOIST GIRDERS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.2.3		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Installation of open-web steel joists and joist girders	OBSERVE	✓ End connections – welded or bolted ✓ Bridging – horizontal and diagonal

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - CONCRETE CONSTRUCTION SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Inspect reinforcement, including prestressing tendons, and verify placement.	OBSERVE	Verify prior to placing concrete that reinforcing is of specified type, grade and size; that it is free of oil, dirt and unacceptable rust; that it is located and spaced properly; that hooks, bends, ties, stirrups and supplemental reinforcement are placed correctly; that lap lengths, stagger and offsets are provided; and that all mechanical connections are installed per the manufacturer's instructions and/or evaluation report.
2. Reinforcing bar welding	OBSERVE	✓ Verify weldability of reinforcing bars other than ASTM A 706 ✓ Inspect single-pass fillet welds, maximum 5/16" in accordance with AWS D1.4
3. All other welding	CONTINUOUS	Visually inspect all welds in accordance with AWS D1.4
4. Cast in place anchors and post installed drilled anchors (downward inclined)	OBSERVE	Verify prior to placing concrete that cast in place anchors and post installed drilled anchors have proper embedment, spacing and edge distance.
5. Post-installed adhesive anchors in horizontal or upward inclined orientations	CONTINUOUS AND DOCUMENT	✓ Inspect as required per approved ICC-ES report ✓ Verify that installer is certified for installation of horizontal and overhead installation applications ✓ Inspect proof loading as required by the contract documents
6. Verify use of required mix design	OBSERVE	Verify that all mixes used comply with the approved construction documents
7. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete	CONTINUOUS	At the time fresh concrete is sampled to fabricate specimens for strength test verify these tests are performed by qualified technicians.
8. Inspect concrete and/or shotcrete placement for proper application techniques	CONTINUOUS	Verify proper application techniques are used during concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.
9. Verify maintenance of specified curing temperature and technique	OBSERVE	Inspect curing, cold weather protection, and hot weather protection procedures.
10. Pre-stressed concrete	CONTINUOUS	Verify application of prestressing forces and grouting of bonded prestressing tendons.

CONTINUED ON FOLLOWING PAGE

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - CONCRETE CONSTRUCTION (CONTINUED)

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE ¹	DESCRIPTION
11. Inspect erection of precast concrete members	OBSERVE	
12. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	OBSERVE	
13. Inspect formwork for shape, location and dimensions of the concrete member being formed.	OBSERVE	

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - MASONRY CONSTRUCTION SECTION (ALL RISK CATEGORIES)**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE <u>AT START</u> OF CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Compliance with approved submittals prior to start	OBSERVE	
2. Proportions of site-mixed mortar.	OBSERVE	
3. Grade and type of reinforcement, anchor bolts, and prestressing tendons and anchorages	OBSERVE	
4. Prestressing technique	OBSERVE	
5. Properties of thin bed mortar for AAC masonry	OBSERVE	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE <u>PRIOR TO</u> GROUTING IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE ¹	DESCRIPTION
6. Grout space	OBSERVE	
7. Proportions of site-prepared grout and prestressing grout for bonded tendons	OBSERVE	
8. Proportions of site-mixed grout and prestressing grout for bonded tendons	OBSERVE	
9. Placement of masonry units and mortar joints	OBSERVE	
10. Welding of reinforcement	CONTINUOUS	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE <u>DURING</u> CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE ¹	DESCRIPTION
11. Size and location of structural elements is in compliance	OBSERVE	
12. Preparation, construction, and protection of masonry during cold weather (temperature below 40°F (4.4°C) or hot weather (temp above 90°F (32.2°C))	OBSERVE	
13. Application and measurement of prestressing force	CONTINUOUS	
14. Placement of grout and prestressing grout for bonded tendons	CONTINUOUS	
15. Placement of AAC masonry units and construction of thin bed mortar joints	CONTINUOUS	Continuous for first 5000 square feet only (465 square meters).
16. Observe preparation of grout specimens, mortar specimens, and/or prisms	OBSERVE	
17. Type, size and placement of reinforcement, connectors, anchor bolts and prestressing tendons and anchorages, including details of anchorage of masonry to structural members, frames, or other construction	OBSERVE	

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - WOOD CONSTRUCTION – SPECIALTY ITEMS SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

WOOD CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.5		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. High-load diaphragms where applicable	OBSERVE	Verify thickness and grade of sheathing, size of framing members at panel edges, nail diameters and length, and the number of fastener lines and that fastener spacing is per approved contract documents.
2. Metal-plate connected wood trusses spanning 60 feet or greater	OBSERVE	Verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package

END SECTION**STRUCTURAL - WOOD CONSTRUCTION - SEISMIC & WIND SECTION****THIS SECTION IS APPLICABLE IF BOX IS CHECKED:** ☐

WOOD CONSTRUCTION SEISMIC AND WIND – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.11 & 1705.12.2		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Nailing, bolting, anchoring and other fastening of elements of the main wind/seismic force-resisting system	OBSERVE (CONTINUOUS FOR GLUING)	Includes connectors for: shearwall sheathing, roof/floor sheathing, drag struts/collectors (double top plates), braces, hold downs, roof connections to exterior walls.

END SECTION**STRUCTURAL – ISOLATION AND ENERGY DISSIPATION SYSTEMS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

ISOLATION AND ENERGY DISSIPATION SYSTEMS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC TABLE 1705.12.8		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Fabrication and installation	OBSERVE	Verify that fabrication and installation of isolator units and energy dissipation devices conform to manufacturer's recommendations and approved construction documents
2. Testing of seismic isolation Systems in seismically isolated structures		Seismic Isolation Systems in seismically isolated structures shall be tested accordance with ASCE 7, Section 17.8

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

GEOTECHNICAL - SOILS INSPECTION SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

SOILS INSPECTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.6		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Materials below shallow foundations are adequate to achieve the design bearing capacity.	OBSERVE	
2. Excavations are extended to proper depth and have reached proper material	OBSERVE	
3. Perform classification and testing of compacted fill materials	OBSERVE	
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill	CONTINUOUS	
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	OBSERVE	During fill placement, the special inspector shall verify that proper materials and procedures are used in accordance with the provisions of the approved geotechnical report

END SECTION**GEOTECHNICAL - DRIVEN DEEP FOUNDATION ELEMENTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

DEEP DRIVEN FOUNDATION CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.7		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Verify element materials, sizes and lengths comply with requirements	CONTINUOUS	
2. Inspect driving operations and maintain complete and accurate records for each element	CONTINUOUS	
3. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element	CONTINUOUS	
4. Determine capacities of test elements and conduct additional load tests if required.	CONTINUOUS	
5. For steel or concrete elements, perform additional special inspections in accordance with the Steel and Concrete sections in this schedule		

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

GEOTECHNICAL - HELICAL PILE FOUNDATIONS SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

HELICAL PILE FOUNDATIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE
2018 IBC 1705.9

TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Record installation equipment used, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data as required. The approved geotechnical report and the contract documents shall be used to determine compliance	CONTINUOUS	

END SECTION**GEOTECHNICAL - CAST IN PLACE DEEP FOUNDATION ELEMENTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

CAST IN PLACE DEEP FOUNDATION ELEMENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE
2018 IBC 1705.8

TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Inspect drilling operations and maintain complete and accurate records for each element.	CONTINUOUS	
2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes	CONTINUOUS	For concrete elements, perform additional special inspections in accordance with the Concrete section in this schedule

END SECTION

¹ **CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

FIRE PROTECTION - SPRAYED FIRE-RESISTANT MATERIALS SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

SPRAYED FIRE RESISTANT MATERIALS (SFRM) – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.14		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Substrate condition	OBSERVE	Prior to application, confirm that surfaces have been prepared according to the approved fire-resistance design and manufacturer's instructions.
2. Material thickness	OBSERVE	Verify SFRM thickness according to 2018 IBC 1705.14.4
3. Material density	OBSERVE	Verify SFRM density according to 2018 IBC 1705.14.5
4. Bond strength	OBSERVE	Verify bond strength of cured SFRM according to IBC 1705.14.6

END SECTION**FIRE PROTECTION - MASTIC AND INTUMESCENT COATINGS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.15		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Inspect according to AWCI 12-B and the contract documents	OBSERVE	Inspections shall be performed in accordance with AWCI 12-B, Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-Resistive Materials.

END SECTION**FIRE PROTECTION – FIRE RESISTANT PENETRATIONS AND JOINTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☒

FIRE RESISTANT PENETRATIONS AND JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.17		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Inspections of penetration firestop systems conducted in accordance with ASTM E 2174.	OBSERVE	
2. Inspections of fire-resistant joint systems conducted in accordance with ASTM E 2393	OBSERVE	

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

FIRE PROTECTION – SMOKE CONTROL SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐**SMOKE CONTROL – VERIFY THE FOLLOWING ARE IN COMPLIANCE**
2018 IBC 1705.18

TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Verify device locations and perform leakage testing	OBSERVE	Perform during erection of ductwork and prior to concealment
2. Pressure difference testing, flow measurements and detection and control verification	OBSERVE	Perform prior to occupancy and after sufficient completion

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

ARCHITECTURAL - EXTERIOR INSULATION AND FINISH SYSTEMS SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS) – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.16		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Water resistive barrier coating applied over a sheathing substrate.	OBSERVE	Verify that water resistive barrier coating complies with ASTM E 2570.

END SECTION**ARCHITECTURAL – ARCHITECTURAL COMPONENTS****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

ARCHITECTURAL COMPONENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.12.5, 1705.12.7		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Erection and fastening of exterior cladding and interior and exterior veneer.	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. Inspector Note: Inspection not required if height is less than 30 feet or weight is less than 5psf
2. Interior and exterior non-load bearing walls	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. Inspector Note: Inspection not required if interior non-load bearing walls weigh less than 15psf
3. Access floors	OBSERVE	Verify that anchorage complies with approved construction documents.
4. Storage racks	OBSERVE	Verify that anchorage complies with approved construction documents. Inspection of post-installed anchors shall comply with approved ICC-ES report. Inspector Note: Not required for racks less than 8 feet in height

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

PLUMBING/MECHANICAL/ELECTRICAL DESIGNATED SEISMIC SYSTEMS SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐**

PLUMBING, MECHANICAL AND ELECTRICAL IBC 1705.12.6		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Anchorage of electrical equipment for emergency and standby power systems	OBSERVE	✓ Check for general conformance
2. Anchorage of all other electrical equipment in Seismic Design Categories E and F only (See first page of this schedule for Seismic Design Category)	OBSERVE	✓ Check for general conformance
3. Installation and anchorage of piping designed to carry hazardous materials and their associated mechanical units.	OBSERVE	✓ Check for general conformance
4. Installation and anchorage of vibration isolation systems where the construction documents require a nominal clearance of ¼" or less between support framing and restraint.	OBSERVE	✓ Check for general conformance
5. Verification of clearance between fire sprinkler piping and surrounding mechanical and electrical equipment, including ductwork, piping and their structural supports.	OBSERVE	✓ Check for minimum clearances noted in ASCE7 13.2.3 or a nominal clearance of not less than 3 inches

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

Project: NOAA OMAO Ship & Support Facility Relocation
 Location: Newport, RI
 Project #: 1562331
 Date: 3/11/2022



WATERFRONT STATEMENT OF SPECIAL INSPECTIONS

Project Seismic Design Category: D
 Project Risk Category: IV
 Project Design Wind Speed (mph): 138
 Number of Stories: 1
 Structure Height Above Grade (ft): 40 Height above Mudline at Pierhead Line
 Hazardous Occupancy or attached to such? No Group H Occupancies

Special Inspector of Record (SIOR)

A Special Inspector of Record (SIOR) IS required (per UFGS 01 45 35, Section 1.3.8)

SIOR Name (Registered Professional): Contractor to provide prior to construction start.

Professional Registration Number: _____

Consulting Firm Name (if any): _____

SIOR Office AND Mobile Phone Number: _____

Lateral Force Resisting System (LFRS)

2018 IBC 1704.3.2 and 1704.3.3

Following is a listing of critical main wind/seismic force resisting systems for this structure. Carefully inspect these elements as part of the roles and responsibilities of the Special Inspector (reference the Schedule of Special Inspections for inspection checklists).

Vertical LFRS Elements	Notes
ASCE 61 Pile to Cap Connections	First stage Trestle and Pier Pile Caps, bulkhead cap
Horizontal LFRS Elements	Notes
Concrete topping slab over p/s planks	Trestle and Pier
ASCE 61 Keyed expansion joint	Between Trestle Bent 19 and Pier Bent 20

Project: NOAA OMAO Ship & Support Facility Relocation
Location: Newport, RI
Project #: 1562331
Date: 3/11/2022

Designated Seismic Systems (DSS)

(2018 IBC 1705.13.3) (ASCE 7-16, 13.2.2, C13.2.2) (UFC 3-301-1, 2-5.3)

Non-structural 'Designated Seismic Systems' (DSS) must remain operable and contain hazardous substances following a design earthquake. Accordingly, all Designated Seismic Systems must be listed below and must be certified by the manufacturer to remain both operable and/or to contain hazardous substances after a design earthquake per UFC 3-301-01, Section 3-6.2. Submit said Certificates of Compliance to the Contracting Officer for each DSS after they have been reviewed and accepted by the EOR/DOR.

Additionally, the below listed Designated Seismic Systems must be carefully inspected by the Special Inspector according to the requirements noted in the Schedule of Special Inspections, Section AA.

ELECTRICAL Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

1.	DSS Component XX
2.	DSS Component XX
3.	DSS Component XX
4.	DSS Component XX
5.	DSS Component XX

If additional space is required, append an additional sheet listing the remaining DSS

MECHANICAL/PLUMBING Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

1.	DSS Gas lines and associated fittings, anchorage, & flexible Connections
2.	DSS Component XX
3.	DSS Component XX
4.	DSS Component XX
5.	DSS Component XX
6.	DSS Component XX

If additional space is required, append an additional sheet listing the remaining DSS

OTHER Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

1.	DSS Component XX
2.	DSS Component XX
3.	DSS Component XX
4.	DSS Component XX
5.	DSS Component XX
6.	DSS Component XX

Final Walk Down Inspection and Report

(UFC 3 301 01 SECTION 2-5.4)

Designated Seismic Systems shall receive a final walk-down inspection by the Registered Design Professional in Responsible Charge

Final Walk Down Report, Prepared by the Registered Design Professional in Responsible Charge, Must Include:

1. Record observations of Final Walk Down Inspection
2. Document that Inspections were performed in accordance with the Schedule of Special Inspections
3. Document that all Designated Seismic Systems are installed according to construction/manufacture document requirements, and that Compliance Certificates have been collected (UFC 03 301 01, 3-6.2, 13.2.2.2).

WATERFRONT SCHEDULE OF SPECIAL INSPECTIONS

Reference UFGS 01 45 35 for all requirements not noted as part of this schedule.

INSPECTION DEFINITIONS:

- PERFORM:** Perform these tasks for each weld, fastener, or bolted connection, and noted verification.
- OBSERVE:** Observe these items randomly during the course of each work day to insure that applicable requirements are being met. Operations need not be delayed pending these inspections at contractor's risk.
- DOCUMENT:** Document, with a report, that the work has been performed in accordance with the contract documents. This is in addition to any other reports required in the Special Inspections guide specification.
- CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

The Seismic Design Category for this project is: ☐ A, ☐ B, ☐ C, ☒ D, ☐ E, ☐ F (check appropriate box)

STRUCTURAL - STEEL – WELDING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

STEEL INSPECTION <u>PRIOR TO WELDING</u> – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-1		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Verify that the welding procedures specification (WPS) is available	PERFORM	
2. Verify manufacturer certifications for welding consumables are available	PERFORM	
3. Verify material identification	PERFORM	Type and grade.
4. Welder Identification System	PERFORM	The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.
5. Fit-up of groove welds (including joint geometry)	OBSERVE	<ul style="list-style-type: none"> ✓ Joint preparation ✓ Dimensions (alignment, root opening, root face, bevel) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location) ✓ Backing type and fit (if applicable)
6. Configuration and finish of access holes	OBSERVE	
7. Fit-up of fillet welds	OBSERVE	<ul style="list-style-type: none"> ✓ Dimensions (alignment, gaps at root) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location)
STEEL INSPECTION <u>DURING WELDING</u> – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-2		
TASK	INSPECTION TYPE	DESCRIPTION
8. Use of qualified welders	PERFORM	Welding by welders, welding operators, and tack welders who are qualified in conformance with requirements.
9. Control and handling of welding consumables	OBSERVE	<ul style="list-style-type: none"> ✓ Packaging ✓ Electrode atmospheric exposure control
10. No welding over cracked tack welds	OBSERVE	
11. Environmental conditions	OBSERVE	<ul style="list-style-type: none"> ✓ Wind speed within limits ✓ Precipitation and temperature
12. Welding Procedures Specification followed	OBSERVE	<ul style="list-style-type: none"> ✓ Settings on welding equipment ✓ Travel speed ✓ Selected welding materials ✓ Shielding gas type/flow rate ✓ Preheat applied ✓ Interpass temperature maintained (min./max.) ✓ Proper position (F, V, H, OH) ✓ Intermix of filler metals avoided
13. Welding techniques	OBSERVE	<ul style="list-style-type: none"> ✓ Interpass and final cleaning ✓ Each pass within profile limitations ✓ Each pass meets quality requirements

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - STEEL – WELDING SECTION (CONTINUED)

STEEL INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-3		
TASK	INSPECTION TYPE ¹	DESCRIPTION
14. Welds cleaned	OBSERVE	
15. Size, length, and location of all welds	PERFORM	Size, length, and location of all welds conform to the requirements of the detail drawings.
16. Welds meet visual acceptance criteria	PERFORM AND DOCUMENT	<ul style="list-style-type: none"> ✓ Crack prohibition ✓ Weld/base-metal fusion ✓ Crater cross section ✓ Weld profiles ✓ Weld size ✓ Undercut ✓ Porosity
17. Arc strikes	PERFORM	
18. k-area	PERFORM	When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks.
19. Backing removed, weld tabs removed and finished, and fillet welds added where required	PERFORM	
20. Repair activities	PERFORM AND DOCUMENT	
21. Document acceptance or rejection of welded joint or member	PERFORM	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL – BOLTING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

STEEL INSPECTION TASKS PRIOR TO BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-1		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Manufacture's certifications available for fastener materials	PERFORM	
2. Fasteners marked in accordance with ASTM requirements	OBSERVE	
3. Proper fasteners selected for joint detail (grade, type, bolt length if threads are to be excluded from shear plane)	OBSERVE	
4. Proper bolting procedure selected for joint detail	OBSERVE	
5. Connecting elements, including appropriate faying surface condition and hole preparation, if specified, meet applicable requirements	OBSERVE	
6. Proper storage provided for bolts, nuts, washers, and other fastener components	OBSERVE	
STEEL INSPECTION TASKS DURING BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-2		
TASK	INSPECTION TYPE ¹	DESCRIPTION
7. Fastener assemblies of suitable condition, placed in all holes and washers (if required) are positioned as required	OBSERVE	
8. Joint brought to the snug-tight condition prior to pretensioning operation	OBSERVE	
9. Fastener component not turned by the wrench prevented from rotating	OBSERVE	
10. Bolts are pretensioned in accordance with RCSC Specification, progressing systematically from the most rigid point toward the free edges	OBSERVE	
STEEL INSPECTION TASKS AFTER BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.1, AISC 360-10: Table C-N5.6-3		
TASK	INSPECTION TYPE ¹	DESCRIPTION
11. Document acceptance or rejection of all bolted connections	DOCUMENT	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL - NON DESTRUCTIVE TESTING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Section N5.5		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Use of qualified nondestructive testing personnel	PERFORM	Visual weld inspection and nondestructive testing (NDT) shall be conducted by personnel qualified in accordance with AWS D1.8 clause 7.2
2. Welded joints subject to fatigue	OBSERVE	Dye penetrant testing (DT) and Ultrasonic testing (UT) shall be performed on 100% of welded joints identified on contract drawings as being subject to fatigue.
3. Weld tab removal sites	OBSERVE	At the end of welds where weld tabs have been removed, magnetic particle testing shall be performed on the same beam-to-column joints receiving UT

END SECTION**STRUCTURAL - STEEL - OTHER INSPECTIONS****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

OTHER STEEL INSPECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Tables J8.1 & J10.1		
TASK	INSPECTION TYPE ⁴	DESCRIPTION
1. Anchor rods and other embedments supporting structural steel	PERFORM	Verify the diameter, grade, type, and length of the anchor rod or embedded item, and the extent or depth of embedment prior to placement of concrete.
2. Fabricated steel or erected steel frame	N/A	
3. Reduced beam sections (RBS) where/if occurs	N/A	
4. Protected zones	N/A	
5. Steel piles	DOCUMENT	No unapproved holes or attachments made by the responsible contractor

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

⁴ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - CONCRETE CONSTRUCTION SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE ⁸	DESCRIPTION
1. Inspect reinforcement, including prestressing tendons, and verify placement.	OBSERVE	Verify prior to placing concrete that reinforcing is of specified type, grade and size; that it is free of oil, dirt and unacceptable rust; that it is located and spaced properly; that hooks, bends, ties, stirrups and supplemental reinforcement are placed correctly; that lap lengths, stagger and offsets are provided; and that all mechanical connections are installed per the manufacturer's instructions and/or evaluation report.
2. Reinforcing bar welding	OBSERVE	✓ Verify weldability of reinforcing bars other than ASTM A 706 ✓ Inspect single-pass fillet welds, maximum 5/16" in accordance with AWS D1.4
3. All other welding	CONTINUOUS	Visually inspect all welds in accordance with AWS D1.4
4. Cast in place anchors and post installed drilled anchors (downward inclined)	OBSERVE	Verify prior to placing concrete that cast in place anchors and post installed drilled anchors have proper embedment, spacing and edge distance.
5. Post-installed adhesive anchors in horizontal or upward inclined orientations	CONTINUOUS AND DOCUMENT	✓ Inspect as required per approved ICC-ES report ✓ Verify that installer is certified for installation of horizontal and overhead installation applications ✓ Inspect proof loading as required by the contract documents
6. Verify use of required mix design	OBSERVE	Verify that all mixes used comply with the approved construction documents
7. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete	CONTINUOUS	At the time fresh concrete is sampled to fabricate specimens for strength test verify these tests are performed by qualified technicians.
8. Inspect concrete and/or shotcrete placement for proper application techniques	CONTINUOUS	Verify proper application techniques are used during concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.
9. Verify maintenance of specified curing temperature and technique	OBSERVE	Inspect curing, cold weather protection, and hot weather protection procedures.
10. Pre-stressed concrete	CONTINUOUS	Verify application of prestressing forces and grouting of bonded prestressing tendons.

CONTINUED ON FOLLOWING PAGE

⁸ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - CONCRETE CONSTRUCTION (CONTINUED)

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE ⁹	DESCRIPTION
11. Inspect erection of precast concrete members	OBSERVE	
12. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	OBSERVE	
13. Inspect formwork for shape, location and dimensions of the concrete member being formed.	OBSERVE	

END SECTION

⁹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

GEOTECHNICAL - SOILS INSPECTION SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

SOILS INSPECTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.6		
TASK	INSPECTION TYPE ¹²	DESCRIPTION
1. Materials below shallow foundations are adequate to achieve the design bearing capacity.	N/A	
2. Excavations are extended to proper depth and have reached proper material	OBSERVE	
3. Perform classification and testing of compacted fill materials	OBSERVE	
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill	CONTINUOUS	
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	OBSERVE	During fill placement, the special inspector shall verify that proper materials and procedures are used in accordance with the provisions of the approved geotechnical report

END SECTION**GEOTECHNICAL - DRIVEN DEEP FOUNDATION ELEMENTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

DEEP DRIVEN FOUNDATION CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.7		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Verify element materials, sizes and lengths comply with requirements	CONTINUOUS	
2. Inspect driving operations and maintain complete and accurate records for each element	CONTINUOUS	
3. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element, document all encounters with rock above minimum tip elevation, and methods used to clear obstruction.	CONTINUOUS	
4. Determine capacities of test elements and conduct additional load tests if required.	CONTINUOUS	
5. For steel or concrete elements, perform additional special inspections in accordance with the Steel and Concrete sections in this schedule		

END SECTION

¹² **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

GEOTECHNICAL - CAST IN PLACE DEEP FOUNDATION ELEMENTS SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐**

CAST IN PLACE DEEP FOUNDATION ELEMENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.8		
TASK	INSPECTION TYPE ¹³	DESCRIPTION
1. Inspect drilling operations and maintain complete and accurate records for each element. Including use of drill to clear obstruction above indicated minimum tip elevation.	CONTINUOUS	
2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes	CONTINUOUS	For concrete elements, perform additional special inspections in accordance with the Concrete section in this schedule

TASK**INSPECTION TYPE ¹³****DESCRIPTION**

1. Inspect drilling operations and maintain complete and accurate records for each element. Including use of drill to clear obstruction above indicated minimum tip elevation.

CONTINUOUS

2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes

CONTINUOUS

For concrete elements, perform additional special inspections in accordance with the Concrete section in this schedule

END SECTION

¹³ **CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

FIRE PROTECTION - SPRAYED FIRE-RESISTANT MATERIALS SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

SPRAYED FIRE RESISTANT MATERIALS (SFRM) – VERIFY THE FOLLOWING ARE IN COMPLIANCE
2018 IBC 1705.14

TASK	INSPECTION TYPE ¹⁴	DESCRIPTION
1. Substrate condition	OBSERVE	Prior to application, confirm that surfaces have been prepared according to the approved fire-resistance design and manufacturer's instructions.
2. Material thickness	OBSERVE	Verify SFRM thickness according to 2018 IBC 1705.14.4
3. Material density	OBSERVE	Verify SFRM density according to 2018 IBC 1705.14.5
4. Bond strength	OBSERVE	Verify bond strength of cured SFRM according to IBC 1705.14.6

END SECTION**FIRE PROTECTION - MASTIC AND INTUMESCENT COATINGS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS – VERIFY THE FOLLOWING ARE IN COMPLIANCE
2018 IBC 1705.15

TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Inspect according to AWCI 12-B and the contract documents	OBSERVE	Inspections shall be performed in accordance with AWCI 12-B, Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-Resistive Materials.

END SECTION**FIRE PROTECTION – FIRE RESISTANT PENETRATIONS AND JOINTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

FIRE RESISTANT PENETRATIONS AND JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE
2018 IBC 1705.17

TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Inspections of penetration firestop systems conducted in accordance with ASTM E 2174.	OBSERVE	
2. Inspections of fire-resistant joint systems conducted in accordance with ASTM E 2393	OBSERVE	

END SECTION

¹⁴ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

FIRE PROTECTION – SMOKE CONTROL SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐

SMOKE CONTROL – VERIFY THE FOLLOWING ARE IN COMPLIANCE
2018 IBC 1705.18

TASK	INSPECTION TYPE ¹⁵	DESCRIPTION
1. Verify device locations and perform leakage testing	OBSERVE	Perform during erection of ductwork and prior to concealment
2. Pressure difference testing, flow measurements and detection and control verification	OBSERVE	Perform prior to occupancy and after sufficient completion

END SECTION

¹⁵ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

PLUMBING/MECHANICAL/ELECTRICAL DESIGNATED SEISMIC SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

PLUMBING, MECHANICAL AND ELECTRICAL IBC 1705.12.6		
TASK	INSPECTION TYPE ¹⁷	DESCRIPTION
1. Anchorage of electrical equipment for emergency and standby power systems	OBSERVE	✓ Check for general conformance
2. Anchorage of all other electrical equipment in Seismic Design Categories E and F only (See first page of this schedule for Seismic Design Category)	OBSERVE	✓ Check for general conformance
3. Installation and anchorage of piping designed to carry hazardous materials and their associated mechanical units.	OBSERVE	✓ Check for general conformance
4. Installation and anchorage of vibration isolation systems where the construction documents require a nominal clearance of ¼" or less between support framing and restraint.	OBSERVE	✓ Check for general conformance
5. Verification of clearance between fire sprinkler piping and surrounding mechanical and electrical equipment, including ductwork, piping and their structural supports.	OBSERVE	✓ Check for minimum clearances noted in ASCE7 13.2.3 or a nominal clearance of not less than 3 inches

END SECTION

¹⁷ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
11/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C511 (2017) Reduced-Pressure Principle Backflow
Prevention Assembly

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 241 (2019) Standard for Safeguarding
Construction, Alteration, and Demolition
Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety -- Safety and Health
Requirements Manual

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD (2009; Rev 2012) Manual on Uniform Traffic
Control Devices

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction Site Plan; G

Traffic Control Plan; G

Haul Road Plan; G

Contractor Computer Cybersecurity Compliance Statements; G

Contractor Temporary Network Cybersecurity Compliance Statements; G

SD-03 Product Data

Backflow Preventers; G

SD-06 Test Reports

Backflow Preventer Tests

SD-07 Certificates

Backflow Tester Certification

Backflow Preventers Certificate of Full Approval

1.3 CONSTRUCTION SITE PLAN

Prior to the start of work, submit for Government approval a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

1.4 BACKFLOW PREVENTERS CERTIFICATE

1.4.1 Backflow Tester Certificate

Prior to testing, submit to the Contracting Officer certification issued by the State or local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory agency. Tester must not be affiliated with a company participating in other phases of this Contract.

1.4.2 Backflow Prevention Training Certificate

Submit a certificate recognized by the State or local authority that states the Contractor has completed at least 10 hours of training in backflow preventer installations. The certificate must be current.

1.5 DOD CONDITION OF READINESS (COR)

DOD will set the Condition of Readiness (COR) based on the weather forecast for sustained winds 50 knots (58 mph) or greater. Contact the Contracting Officer for the current COR setting.

Monitor weather conditions a minimum of twice a day and take appropriate actions according to the approved Emergency Plan in the accepted Accident Prevention Plan, EM 385-1-1 Section 01 Emergency Planning and the instructions below.

Unless otherwise directed by the Contracting Officer, comply with:

- a. Condition FOUR (Sustained winds of 58 mph or greater expected within 72 hours): Normal daily jobsite cleanup and good housekeeping practices. Collect and store in piles or containers scrap lumber,

waste material, and rubbish for removal and disposal at the close of each work day. Maintain the construction site including storage areas, free of accumulation of debris. Stack form lumber in neat piles less than 3.3 feet high. Remove all debris, trash, or objects that could become missile hazards. Review requirements pertaining to "Condition THREE" and continue action as necessary to attain "Condition FOUR" readiness. Contact Contracting Officer for weather and COR updates and completion of required actions.

- b. Condition THREE (Sustained winds of 58 mph or greater expected within 48 hours): Maintain "Condition FOUR" requirements and commence securing operations necessary for "Condition ONE" which cannot be completed within 18 hours. Cease all routine activities which might interfere with securing operations. Commence securing and stow all gear and portable equipment. Make preparations for securing buildings. Reinforce or remove formwork and scaffolding. Secure machinery, tools, equipment, materials, or remove from the jobsite. Expend every effort to clear all missile hazards and loose equipment from general base areas. Contact Contracting Officer for weather and COR updates and completion of required actions. Review requirements pertaining to "Condition TWO" and continue action as necessary to attain "Condition THREE" readiness.
- c. Condition TWO (Sustained winds of 58 mph or greater expected within 24 hours): Secure the jobsite, and leave Government premises.
- d. Condition ONE. (Sustained winds of 58 mph or greater expected within 12 hours): Contractor access to the jobsite and Government premises is prohibited.

1.6 CYBERSECURITY DURING CONSTRUCTION

{For Reference Only: This subpart (and its subparts) relates to AC-18, SA-3, CCI-00258.} Meet the following requirements throughout the construction process.

1.6.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. When used, contractor computers must meet the following requirements:

1.6.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

1.6.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates, and must use the latest definitions file. All computers used on this project must be scanned using the installed software at least once per day.

1.6.1.3 Passwords and Passphrases

The passwords and passphrases for all computers must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.6.1.4 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using contractor owned computers. Contractor Computer Cybersecurity Compliance Statements must use the template published at <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>. Each Statement must be signed by a cybersecurity representative for the relevant company.

1.6.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks must meet the following requirements:

1.6.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than IP networks provided under this project or Government furnished IP networks provided for this purpose. Any and all network access from outside the project site is prohibited.

1.6.3 Government Access to Network

Government personnel must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification.

1.6.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks must not interfere with existing wireless network and must use WPA2 security. Network names (SSID) for wireless networks must be changed from their default values.

1.6.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.6.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. Contractor Temporary Network Cybersecurity Compliance Statements must use the template published at <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>. Each Statement must be signed by a cybersecurity representative for the relevant company. If no temporary IP networks will

be used, provide a single copy of the Statement indicating this.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Prior to the commencement of work activities, provide a clear weatherproof covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the Contract, Wage Rate Information poster, Safety and Health Information as required by EM 385-1-1 Section 01 and other information approved by the Contracting Officer. Coordinate requirements herein with 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, and in location as approved by the Contracting Officer.

2.1.2 Project Identification Signs

The requirements for the signs, their content, and location are as specified in Section 01 58 00 PROJECT IDENTIFICATION. Erect signs within 15 days after receipt of the notice to proceed. Correct the data required by the safety sign daily, with light colored metallic or non-metallic numerals.

2.1.3 Warning Signs

Post temporary signs, tags, and labels to give workers and the public adequate warning and caution of construction hazards according to the EM 385-1-1 Section 04. Attach signs to the perimeter fencing every 150 feet warning the public of the presence of construction hazards. Signs must require unauthorized persons to keep out of the construction site. Correct the data required by safety signs daily. Post signs at all points of entry designating the construction site as a hard hat area.

2.2 TEMPORARY TRAFFIC CONTROL

2.2.1 Haul Roads

Construct access and haul roads necessary for proper prosecution of the work under this Contract in accordance with EM 385-1-1 Section 04. Construct with suitable grades and widths; avoid sharp curves, blind corners, and dangerous cross traffic. Submit haul road plan for approval. Provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, must be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and haul roads are subject to approval by the Contracting Officer. Lighting must be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations.

2.2.2 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Barricades are required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of

both pedestrian and vehicular traffic. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.3 FENCING

Provide fencing along the construction site and at all open excavations and tunnels to control access by unauthorized personnel. Safety fencing must be highly visible to be seen by pedestrians and vehicular traffic. All fencing must meet the requirements of EM 385-1-1. Remove the fence upon completion and acceptance of the work.

2.3.1 Polyethylene Mesh Safety Fencing

Temporary safety fencing must be a high visibility orange colored, high density polyethylene grid, a minimum of 48 inches high and maximum mesh size of 2 inches. Fencing must extend from the grade to a minimum of 48 inches above the grade and be tightly secured to T-posts spaced as necessary to maintain a rigid and taut fence. Fencing must remain rigid and taut with a minimum of 200 pounds of force exerted on it from any direction with less than 4 inches of deflection.

2.3.2 Chain Link Panel Fencing

Temporary panel fencing must be galvanized steel chain link panels 6 feet high. Multiple fencing panels may be linked together at the bases to form long spans as needed. Each panel base must be weighted down using sand bags or other suitable materials in order for the fencing to withstand anticipated winds while remaining upright. Fencing must remain rigid and taut with a minimum of 200 pounds of force exerted on it from any direction with less than 4 inches of deflection.

2.3.3 Post-Driven Chain Link Fencing

Temporary post-driven fencing must be galvanized chain link fencing 6 feet high supported by an tightly secured to galvanized steel posts driven below grade. Fence posts must be located on minimum 10 foot centers. Posts may be set in various surfaces such as sand, soil, asphalt or concrete as necessary. Chain link fencing must remain rigid and taut with a minimum of 200 pounds of force exerted on it from any direction with less than 4 inches of deflection. Completely remove fencing and posts at the completion of construction and restore surfaces disturbed or damaged to its original condition. Locate and identify underground utilities prior to setting fence posts. Equip fence with a lockable gate. Gate must remain locked when construction personnel are not present.

2.4 TEMPORARY WIRING

Provide temporary wiring in accordance with EM 385-1-1 Section 11, NFPA 241 and NFPA 70. Include monthly inspection and testing of all equipment and apparatus.

2.5 BACKFLOW PREVENTERS

Certificate of Full Approval from FCCCHR List, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval is not acceptable.

Reduced pressure principle type conforming to the applicable requirements AWWA C511. Provide backflow preventers complete with 150 pound flanged, bronze, or brass mounted gate valve and strainer bronze, internal parts.

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

Construction Contract employees must park privately owned vehicles in an area designated by the Contracting Officer. Employee parking must not interfere with existing and established parking requirements of the Government installation.

3.2 AVAILABILITY AND USE OF UTILITY SERVICES

3.2.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.

3.2.2 Meters and Temporary Connections

Provide and maintain necessary temporary connections, distribution lines, and meter bases (Government will provide meters) required to measure the amount of each utility used for the purpose of determining charges. Notify the Contracting Officer, in writing, 5 working days before final electrical connection is desired so that a utilities contract can be established. The Government will provide a meter and make the final hot connection after inspection and approval of the Contractor's temporary wiring installation. Do not make the final electrical connection.

3.2.3 Advance Deposit

An advance deposit for utilities consisting of an estimated month's usage or a minimum of \$50.00 will be required. The last monthly bills for the fiscal year will normally be offset by the deposit and adjustments will be billed or returned as appropriate. Services to be rendered for the next fiscal year, beginning 1 October, will require a new deposit. Notification of the due date for this deposit will be mailed prior to the end of the current fiscal year.

3.2.4 Final Meter Reading

Before completion of the work and final acceptance of the work by the Government, notify the Contracting Officer, in writing, 5 working days before termination is desired. The Government will take a final meter reading, disconnect service, and remove the meters. Then remove all the temporary distribution lines, meter bases, and associated appurtenances. Pay all outstanding utility bills before final acceptance of the work by the Government.

3.2.5 Utilities at Special Locations

- a. Reasonable amounts of utilities will be made available at the prevailing Government rates. These rates may be obtained upon application to the Commanding Officer, NAVSTA Newport, by way of the Contracting Officer. Make connections, provide transformers and

meters, and make disconnections; and provide backflow preventer devices on connections to domestic water lines.

3.2.6 Sanitation

Provide and maintain within the construction area minimum field-type sanitary facilities in accordance with EM 385-1-1 Section 02. Locate the facilities behind the construction fence or out of the public view. Clean units and empty wastes at least once a week or more frequently into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into a municipal, district, or commercial sanitary sewer system. Penalties or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Contracting Officer and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times. Include provisions for pest control and elimination of odors. Government toilet facilities will not be available to Contractor's personnel.

3.2.7 Telephone

Make arrangements and pay all costs for telephone facilities desired.

3.2.8 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.3 STATION OPERATION AFFECT ON CONTRACTOR OPERATIONS

3.4 TRAFFIC PROVISIONS

3.4.1 Maintenance of Traffic

- a. Conduct operations in a manner that will not close a thoroughfare or interfere with traffic on railways or highways except with written permission of the Contracting Officer at least 15 calendar days prior to the proposed modification date, and provide a Traffic Control Plan for Government approval detailing the proposed controls to traffic movement for approval. The plan must be in accordance with State and local regulations and the MUTCD, Part VI. Make all notifications and obtain all permits required for modification to traffic movements outside Station's jurisdiction. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.
- b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.
- c. Provide, erect, and maintain, at Contractor's expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, overhead protection authority having jurisdiction.
- d. Provide cones, signs, barricades, lights, or other traffic control devices and personnel required to control traffic. Do not use

foil-backed material for temporary pavement marking because of its potential to conduct electricity during accidents involving downed power lines.

3.4.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Provide self-illuminated (lighted) barricades during hours of darkness. Brightly-colored (orange) vests are required for all personnel working in roadways. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of damage to roads caused by construction operations.

3.4.3 Rush Hour Restrictions

Do not interfere with the peak traffic flows preceding and during normal operations without notification to and approval by the Contracting Officer.

3.4.4 Dust Control

Dust control methods and procedures must be approved by the Contracting Officer. Coordinate dust control methods with 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.

3.5 REDUCED PRESSURE BACKFLOW PREVENTERS

Provide an approved reduced pressure backflow prevention assembly at each location where the Contractor taps into the Government potable water supply.

Perform backflow preventer tests using test equipment, procedures, and certification forms conforming to those outlined in the latest edition of the Manual of Cross-Connection Control published by the FCCCHR Manual. Test and tag each reduced pressure backflow preventer upon initial installation (prior to continued water use) and quarterly thereafter. Tag must contain the following information: make, model, serial number, dates of tests, results, maintenance performed, and signature of tester. Record test results on certification forms conforming to requirements cited earlier in this paragraph.

3.6 CONTRACTOR'S TEMPORARY FACILITIES

Contractor is responsible for security of their property. Provide adequate outside security lighting at the temporary facilities. Trailers must be anchored to resist high winds and meet applicable state or local standards for anchoring mobile trailers. Coordinate anchoring with EM 385-1-1 Section 04. The Contract Clause entitled "FAR 52.236-10, Operations and Storage Areas" and the following apply:

3.6.1 Administrative Field Offices

Provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

In the event a new building is constructed for the temporary project field office, it must be a minimum 12 feet in width, 16 feet in length and have a minimum of 7 feet headroom. Equip the building with approved electrical wiring, at least one double convenience outlet and the required switches and fuses to provide 110-120 volt power. Provide a work table with stool, desk with chair, two additional chairs, and one legal size file cabinet that can be locked. The building must be waterproof, supplied with a heater, have a minimum of two doors, electric lights, a telephone, a battery-operated smoke detector alarm, a sufficient number of adjustable windows for adequate light and ventilation, and a supply of approved drinking water. Provide approved sanitary facilities. Screen the windows and doors and provide the doors with deadbolt type locking devices or a padlock and heavy-duty hasp bolted to the door. Door hinge pins must be non-removable. Arrange the windows to open and to be securely fastened from the inside. Protect glass panels in windows by bars or heavy mesh screens to prevent easy access. In warm weather, provide air conditioning capable of maintaining the office at 50 percent relative humidity and a room temperature 20 degrees F below the outside temperature when the outside temperature is 95 degrees F. Unless otherwise directed by the Contracting Officer, remove the building from the site upon completion and acceptance of the work.

3.6.2 Quality Control Manager Records and Field Office

Provide on the jobsite an office with approximately 100 square feet of useful floor area for the exclusive use of the QC Manager. Provide a weathertight structure with adequate heating and cooling, toilet facilities, lighting, ventilation, a 4 by 8 foot plan table, a standard size office desk and chair, computer station, and working communications facilities. Provide either a 1,500 watt radiant heater and a window-mounted air conditioner rated at 9,000 Btus minimum or a window-mounted heat pump of the same minimum heating and cooling ratings. Provide a door with a cylinder lock and windows with locking hardware. Make utility connections. Locate as directed. File quality control records in the office and make available at all times to the Government. After completion of the work, remove the entire structure from the site.

3.6.3 Storage Area

Construct a temporary 6 foot high chain link fence around trailers and materials. Include plastic strip inserts, colored green, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on the current day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, and will be traversed with construction equipment or other vehicles, must be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers must be edged or trimmed neatly.

3.6.4 Supplemental Storage Area

Upon request, and pending availability, the Contracting Officer will designate another or supplemental area for the use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but will be within the installation boundaries. Maintain the area in a clean and orderly fashion and secured if needed to protect supplies and equipment. Utilities will not be provided to this area by the Government.

3.6.5 Appearance of Trailers

- a. Trailers must be roadworthy and comply with all appropriate state and local vehicle requirements. Trailers which are rusted, have peeling paint or are otherwise in need of repair will not be allowed on Installation property. Trailers must present a clean and neat exterior appearance and be in a state of good repair.
- b. Maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal at the Contractor's expense.

3.6.6 Trailers or Storage Buildings

- a. Trailers or storage buildings will be permitted, where space is available, subject to the approval of the Contracting Officer.
- b. Mount a sign not smaller than 24 by 24 inches on the trailer or building that shows the company name, business phone number, emergency phone number and conforms to the following requirements and sketch:

Graphic panel	Aluminum, painted blue
Copy	Screen painted or vinyl die-cut, white
Typeface	Univers 65 u/lc
See Sketch No. 01500 (graphic).	

3.6.7 Safety Systems

Protect the integrity of all installed safety systems or personnel safety devices. Obtain prior approval from the Contracting Officer if entrance into systems serving safety devices is required. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish Contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or

equipment and obtain approval from the Contracting Officer.

3.6.8 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

3.6.8.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions must include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.

3.7 PLANT COMMUNICATIONS

Whenever the individual elements of the plant are located so that operation by normal voice between these elements is not satisfactory, install a satisfactory means of communication, such as telephone or other suitable devices and make available for use by Government personnel.

3.8 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, furnish and erect temporary project safety fencing at the work site. Maintain the safety fencing during the life of the Contract and, upon completion and acceptance of the work, remove from the work site.

3.9 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store all salvageable materials resulting from demolition activities within the fenced area described above or at the supplemental storage area. Neatly stack stored materials not in trailers, whether new or salvaged.

3.10 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haul roads, and all other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence. Restore areas used during the performance of the Contract to the original or better condition. Remove gravel used to traverse grassed areas and restore the area to its original condition, including top soil and seeding as necessary.

-- End of Section --

SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS

11/15, CHG 4: 08/20

PART 1 GENERAL

Provide appropriate controls to ensure a safe work environment for employees and to protect the public and Government employees, the work site and the environment. Demonstrate how this protection will be accomplished through the development, submission for approval, and implementation of various programs and plans required by this section, inclusive of Section 01 57 19.01 20 SUPPLEMENTAL TEMPORARY ENVIRONMENTAL CONTROLS. These programs and plans must define the controls and procedures to be implemented by the Contractor to provide this protection.

The waterfront and pier landing areas are an Installation Restoration (IR) site. Any excavation in these areas, including water or debris from in-water work, may encounter soil/groundwater contamination or contaminated debris that will require special handling and disposal procedures. For bidding purposes, assume 100% of excavated material in these areas and all debris from in-water work will be contaminated. Refer to 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL.

For excavations outside of the Site 19-OU5 Marine Sediment Land Use Control Area, the Site 19-OU12 On-Shore Soil Land Use Control Area, and the Site 19-OU12 Groundwater Land Use Control Area, refer to 01 57 19.01 20 SUPPLEMENTAL TEMPORARY ENVIRONMENTAL CONTROLS.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846	(Third Edition; Update IV) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1910.1053	Respirable Crystalline Silica
29 CFR 1926.1153	Respirable Crystalline Silica
40 CFR 50	National Primary and Secondary Ambient Air Quality Standards
40 CFR 60	Standards of Performance for New Stationary Sources

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 63	National Emission Standards for Hazardous Air Pollutants for Source Categories
40 CFR 64	Compliance Assurance Monitoring
40 CFR 112	Oil Pollution Prevention
40 CFR 122.26	Storm Water Discharges (Applicable to State NPDES Programs, see section 123.25)
40 CFR 241	Guidelines for Disposal of Solid Waste
40 CFR 243	Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste
40 CFR 258	Subtitle D Landfill Requirements
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 261.7	Residues of Hazardous Waste in Empty Containers
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 262.17	Conditions for Exemption for a Large Quantity Generator That Accumulates Hazardous Waste
40 CFR 262.31	Standards Applicable to Generators of Hazardous Waste-Labeling
40 CFR 262.34	Standards Applicable to Generators of Hazardous Waste-Accumulation Time
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions

40 CFR 273	Standards for Universal Waste Management
40 CFR 273.2	Standards for Universal Waste Management - Batteries
40 CFR 273.4	Standards for Universal Waste Management - Mercury Containing Equipment
40 CFR 273.5	Standards for Universal Waste Management - Lamps
40 CFR 279	Standards for the Management of Used Oil
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 300.125	National Oil and Hazardous Substances Pollution Contingency Plan - Notification and Communications
40 CFR 355	Emergency Planning and Notification
40 CFR 745	Lead-Based Paint Poisoning Prevention in Certain Residential Structures
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 172.101	Hazardous Material Regulation-Purpose and Use of Hazardous Material Table
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases, State of Rhode Island and Providence Plantations, Department of Environmental Management. Office of Waste Management (31 March 1993, as amended November 2011)

Rules and Regulations for Asbestos Control (R23-24.5-ASB), State of Rhode Island and Providence Plantations, Department of Health (as amended September 2012).

NAVAL STATION NEWPORT INSTRUCTIONS AND DIRECTIVES

Record of Decision. Site 19 - Former Derecktor Shipyard Marine Sediment,

Operable Unit 5, Naval Station Newport, Middletown/Newport, Rhode Island.
September 2014.

Record of Decision. Site 19 - On-Shore Derecktor Shipyard Soil and
Groundwater (Operable Unit 12), Naval Station Newport, Middletown/Newport,
Rhode Island. September 2014.

Land Use Control Remedial Design for Site 19 - Former Derecktor Shipyard
Operable Units 5 and 12. Naval Station Newport, Middletown/Newport, Rhode
Island. March 2016.

Table 1. Soil/Sediment Management Determination for Naval Station,
Newport, Rhode Island (20 Jun2022)

Environmental Condition of Property for NOAA OMAO Ship and Support
Facility Relocation at naval Station Newport, Rhode Island. Scheduled for
completion in 2023.

1.2 DEFINITIONS

1.2.1 Class I and II Ozone Depleting Substance (ODS)

Class I ODS is defined in Section 602(a) of The Clean Air Act. A list of
Class I ODS can be found on the EPA website at the following weblink.
<https://www.epa.gov/ozone-layer-protection/ozone-depleting-substances>.

Class II ODS is defined in Section 602(s) of The Clean Air Act. A list of
Class II ODS can be found on the EPA website at the following weblink.
<https://www.epa.gov/ozone-layer-protection/ozone-depleting-substances>.

1.2.2 Contractor Generated Hazardous Waste

Contractor generated hazardous waste is materials that, if abandoned or
disposed of, may meet the definition of a hazardous waste. These waste
streams would typically consist of material brought on site by the
Contractor to execute work, but are not fully consumed during the course
of construction. Examples include, but are not limited to, excess paint
thinners (i.e., methyl ethyl ketone, toluene), waste thinners, excess
paints, excess solvents, waste solvents, excess pesticides, and
contaminated pesticide equipment rinse water.

1.2.3 Electronics Waste

Electronics waste is discarded electronic devices intended for salvage,
recycling, or disposal.

1.2.4 Environmental Pollution and Damage

Environmental pollution and damage are the presence of chemical, physical,
or biological elements or agents which adversely affect human health or
welfare; unfavorably alter ecological balances of importance to human
life; affect other species of importance to humankind; or degrade the
environment aesthetically, culturally, or historically.

1.2.5 Environmental Protection

Environmental protection is the prevention/control of pollution and
habitat disruption that may occur to the environment during construction.
The control of environmental pollution and damage requires consideration

of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.6 Hazardous Debris

As defined in paragraph SOLID WASTE, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) in accordance with 40 CFR 261. Hazardous debris also includes debris that exhibits a characteristic of hazardous waste in accordance with 40 CFR 261.

1.2.7 Hazardous Materials

Hazardous materials as defined in 49 CFR 171 and listed in 49 CFR 172.

Hazardous material is any material that: Is regulated as a hazardous material in accordance with 49 CFR 173; or requires a Safety Data Sheet (SDS) in accordance with 29 CFR 1910.120; or during end use, treatment, handling, packaging, storage, transportation, or disposal meets or has components that meet or have potential to meet the definition of a hazardous waste as defined by 40 CFR 261 Subparts A, B, C, or D. Designation of a material by this definition, when separately regulated or controlled by other sections or directives, does not eliminate the need for adherence to that hazard-specific guidance which takes precedence over this section for "control" purposes. Such material includes ammunition, weapons, explosive actuated devices, propellants, pyrotechnics, chemical and biological warfare materials, medical and pharmaceutical supplies, medical waste and infectious materials, bulk fuels, radioactive materials, and other materials such as asbestos, mercury, and polychlorinated biphenyls (PCBs).

1.2.8 Hazardous Waste

Hazardous Waste is any material that meets the definition of a solid waste and exhibit a hazardous characteristic (ignitability, corrosivity, reactivity, or toxicity) as specified in 40 CFR 261, Subpart C, or contains a listed hazardous waste as identified in 40 CFR 261, Subpart D.

1.2.9 Land Application

Land Application means spreading or spraying discharge water at a rate that allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" must occur. Comply with federal, state, and local laws and regulations.

1.2.10 Municipal Separate Storm Sewer System (MS4) Permit

MS4 permits are those held by installations to obtain NPDES permit coverage for their stormwater discharges.

1.2.11 National Pollutant Discharge Elimination System (NPDES)

The NPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

1.2.12 Oily Waste

Oily waste are those materials that are, or were, mixed with Petroleum, Oils, and Lubricants (POLs) and have become separated from that POLs. Oily wastes also means materials, including wastewaters, centrifuge solids, filter residues or sludges, bottom sediments, tank bottoms, and sorbents which have come into contact with and have been contaminated by, POLs and may be appropriately tested and discarded in a manner which is in compliance with other state and local requirements.

This definition includes materials such as oily rags, "kitty litter" sorbent clay and organic sorbent material. These materials may be land filled provided that: It is not prohibited in other state regulations or local ordinances; the amount generated is "de minimus" (a small amount); it is the result of minor leaks or spills resulting from normal process operations; and free-flowing oil has been removed to the practicable extent possible. Large quantities of this material, generated as a result of a major spill or in lieu of proper maintenance of the processing equipment, are a solid waste. As a solid waste, perform a hazardous waste determination prior to disposal. As this can be an expensive process, it is recommended that this type of waste be minimized through good housekeeping practices and employee education.

1.2.13 Regulated Waste

Regulated waste are solid wastes that have specific additional federal, state, or local controls for handling, storage, or disposal.

1.2.14 Sediment

Sediment is soil and other debris that have eroded and have been transported by runoff water or wind.

1.2.15 Solid Waste

Solid waste is a solid, liquid, semi-solid or contained gaseous waste. A solid waste can be a hazardous waste, non-hazardous waste, or non-Resource Conservation and Recovery Act (RCRA) regulated waste. Types of solid waste typically generated at construction sites may include:

1.2.15.1 Debris

Debris is non-hazardous solid material generated during the construction, demolition, or renovation of a structure that exceeds 2.5-inch particle size that is: a manufactured object; plant or animal matter; or natural geologic material (for example, cobbles and boulders), broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. Inert materials may be reinforced with or contain ferrous wire, rods, accessories and weldments. A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

1.2.15.2 Green Waste

Green waste is the vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be

re-used are not included.

1.2.15.3 Material Not Regulated As Solid Waste

Material not regulated as solid waste is nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

1.2.15.4 Non-Hazardous Waste

Non-hazardous waste is waste that is excluded from, or does not meet, hazardous waste criteria in accordance with 40 CFR 261.

1.2.15.5 Recyclables

Recyclables are materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable, wiring, insulated/non-insulated copper wire cable, wire rope, and structural components. It also includes commercial-grade refrigeration equipment with Freon removed, household appliances where the basic material content is metal, clean polyethylene terephthalate bottles, cooking oil, used fuel oil, textiles, high-grade paper products and corrugated cardboard, stackable pallets in good condition, clean crating material, and clean rubber/vehicle tires. Metal meeting the definition of lead contaminated or lead based paint contaminated may be included as recyclable if sold to a scrap metal company. Paint cans that meet the definition of empty containers in accordance with 40 CFR 261.7 may be included as recyclable if sold to a scrap metal company.

1.2.15.6 Surplus Soil

Surplus soil is existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars, and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included and must be managed in accordance with paragraph 3.7.3 CONTROL AND MANAGEMENT OF HAZARDOUS WASTE.

1.2.15.7 Scrap Metal

This includes scrap and excess ferrous and non-ferrous metals such as reinforcing steel, structural shapes, pipe, and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.

1.2.15.8 Wood

Wood is dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included. Treated wood includes, but is not limited to, lumber, utility poles, crossties, and other wood products with chemical treatment.

1.2.16 Surface Discharge

Surface discharge means discharge of water into drainage ditches, storm sewers, creeks or "waters of the United States". Surface discharges are discrete, identifiable sources and require a permit from the governing agency. Comply with federal, state, and local laws and regulations.

1.2.17 Wastewater

Wastewater is the used water and solids from a community that flow to a treatment plant.

1.2.17.1 Stormwater

Stormwater is any precipitation in an urban or suburban area that does not evaporate or soak into the ground, but instead collects and flows into storm drains, rivers, and streams.

1.2.18 Waters of the United States

Waters of the United States means Federally jurisdictional waters, including wetlands, that are subject to regulation under Section 404 of the Clean Water Act or navigable waters, as defined under the Rivers and Harbors Act.

1.2.19 Wetlands

Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

1.2.20 Universal Waste

The universal waste regulations streamline collection requirements for certain hazardous wastes in the following categories: batteries, pesticides, mercury-containing equipment (for example, thermostats), and lamps (for example, fluorescent bulbs). The rule is designed to reduce hazardous waste in the municipal solid waste (MSW) stream by making it easier for universal waste handlers to collect these items and send them for recycling or proper disposal. These regulations can be found at 40 CFR 273.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Preconstruction Survey

Solid Waste Management Permit; G

Regulatory Notifications; G

Environmental Protection Plan; G

Stormwater Management Plan (SMP); G

Stormwater Notice of Intent for NPDES coverage under the general permit for construction activities; G

Dirt and Dust Control Plan; G

Employee Training Records; G

Environmental Manager Qualifications; G

SD-06 Test Reports

Laboratory Analysis

Inspection Reports

Monthly Solid Waste Disposal Report; G

SD-07 Certificates

Employee Training Records; G

ECATTS Certificate of Completion; G

Erosion and Sediment Control Inspector Qualifications

SD-11 Closeout Submittals

Stormwater Management Plan Compliance Notebook; G

Stormwater Notice of Termination (for NPDES coverage under the general permit for construction activities); G

Waste Determination Documentation; G

Disposal Documentation for Hazardous and Regulated Waste; G

Assembled Employee Training Records; G

Solid Waste Management Permit; G

Project Solid Waste Disposal Documentation Report; G

Contractor Hazardous Material Inventory Log; G

Hazardous Waste/Debris Management; G

Regulatory Notifications; G

Sales Documentation; G

As-Built Topographic Survey

1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective

measures to control pollution that develops during construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Protect the environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire duration of this Contract. Comply with federal, state, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

Tests and procedures assessing whether construction operations comply with Applicable Environmental Laws may be required. Analytical work must be performed by qualified laboratories; and where required by law, the laboratories must be certified.

1.4.1 Training in Environmental Compliance Assessment Training and Tracking System (ECATTS)

1.4.1.1 Personnel Requirements

The Environmental Manager is responsible for environmental compliance on projects. The Environmental Manager and other staff, must complete applicable ECATTS training modules (installation specific or general) prior to starting respective portions of on-site work under this Contract. If personnel changes occur for any of these positions after starting work, replacement personnel must complete applicable ECATTS training within 14 days of assignment to the project.

1.4.1.2 Certification

Submit an ECATTS certificate of completion for personnel who have completed the required ECATTS training. This training is web-based and can be accessed from any computer with Internet access using the following instructions.

Register for NAVFAC Environmental Compliance Assessment, Training, and Tracking System, by logging on to <https://environmentaltraining.ecatts.com/>. Obtain the password for registration from the Contracting Officer.

1.4.1.3 Refresher Training

This training has been structured to allow contractor personnel to receive credit under this contract and to carry forward credit to future contracts. Ensure the Environmental Manager review their training plans for new modules or updated training requirements prior to beginning work. Some training modules are tailored for specific state regulatory requirements; therefore, Contractors working in multiple states will be required to retake modules tailored to the state where the contract work is being performed.

1.4.2 Conformance with the Environmental Management System

Perform work under this contract consistent with the policy and objectives identified in the installation's Environmental Management System (EMS). Perform work in a manner that conforms to objectives and targets of the environmental programs and operational controls identified by the EMS. Support Government personnel when environmental compliance and EMS audits are conducted by escorting auditors at the Project site, answering questions, and providing proof of records being maintained. Provide

monitoring and measurement information as necessary to address environmental performance relative to environmental, energy, and transportation management goals. In the event an EMS nonconformance or environmental noncompliance associated with the contracted services, tasks, or actions occurs, take corrective and preventative actions. In addition, employees must be aware of their roles and responsibilities under the installation EMS and of how these EMS roles and responsibilities affect work performed under the contract.

Coordinate with the installation's EMS coordinator to identify training needs associated with environmental aspects and the EMS, and arrange training or take other action to meet these needs. Provide training documentation to the Contracting Officer. The Installation Environmental Office will retain associated environmental compliance records. Make EMS Awareness training completion certificates available to Government auditors during EMS audits and include the certificates in the Employee Training Records. See paragraph EMPLOYEE TRAINING RECORDS.

1.5 SPECIAL ENVIRONMENTAL REQUIREMENTS

Comply with the special environmental requirements listed here.

National Marine Fisheries Service Incidental Harassment Authorization for Marine Mammals specifying Marine Mammal Monitoring and Hydroacoustic Monitoring requirements. Also refer to Section 01 35 40.00 20 MARINE MAMMAL PROTECTION.

National Marine Fisheries Service Essential Fish Habitat Conservation Measures:

1. The lowermost part of any floats should be >18 inches above the substrate at all times to avoid grounding and scour.
2. Soil erosion, sediment, and turbidity control measures, as included in the project plans and Section 01 57 24 TURBIDITY CONTROL AND MONITORING.
3. Impact pile driving activities must utilize a soft-start procedure as described in part 3.1.4 of this Section.

Comply with Land Use Controls for work within the Pier Landing Area and Waterfront sites as specified for Site 19 On-Shore Derecktor Shipyard, Operable Units 5 and 12 in Land Use Control Remedial Design, NAVSTA Newport, March 2016 (see Attachment B).

Coordinate with the NAVSTA Newport Environmental Office. Also refer to 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL regarding requirements for excavation and handling of contaminated material and 33 51 39 MONITORING WELLS for specifications on abandonment, relocation, and installation of groundwater monitoring wells.

1.6 QUALITY ASSURANCE

1.6.1 Preconstruction Survey and Protection of Features

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, perform a Preconstruction Survey of the project site with the Contracting Officer, and take

photographs showing existing environmental conditions in and adjacent to the site. Submit a report for the record. Include in the report a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s). The Contractor and the Contracting Officer will sign this survey report upon mutual agreement regarding its accuracy and completeness. Protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference that their preservation may cause to the work under the Contract.

1.6.2 Regulatory Notifications

Provide regulatory notification requirements in accordance with federal, state and local regulations. In cases where the Government will also provide public notification (such as stormwater permitting), coordinate with the Contracting Officer. Submit copies of regulatory notifications to the Contracting Officer at least 21 days prior to commencement of work activities. Typically, regulatory notifications must be provided for the following (this listing is not all-inclusive): demolition, renovation, NPDES defined site work, construction, removal or use of a permitted air emissions source, and remediation of controlled substances (asbestos, hazardous waste, lead paint).

1.6.3 Environmental Brief

Attend an environmental brief to be included in the preconstruction meeting. Provide the following information: types, quantities, and use of hazardous materials that will be brought onto the installation; and types and quantities of wastes/wastewater that may be generated during the Contract. Discuss the results of the Preconstruction Survey at this time.

Prior to initiating any work on site, meet with the Contracting Officer, Environmental Design Specialist, Geotechnical Engineer, Hazardous Materials Specialist, Design Manager, and installation Environmental Office to discuss the proposed Environmental Protection Plan (EPP). Develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural and cultural resources, required reports, required permits, permit requirements (such as mitigation measures), and other measures to be taken.

1.6.4 Environmental Manager

Appoint in writing an Environmental Manager for the project site. The Environmental Manager is directly responsible for coordinating contractor compliance with federal, state, local, and installation requirements. The Environmental Manager must ensure compliance with Hazardous Waste Program requirements (including hazardous waste handling, storage, manifesting, and disposal); implement the EPP; ensure environmental permits are obtained, maintained, and closed out; ensure compliance with Stormwater Program requirements; ensure compliance with Hazardous Materials (storage, handling, and reporting) requirements; and coordinate any remediation of regulated substances (lead, asbestos, PCB transformers). This can be a collateral position; however, the person in this position must be trained to adequately accomplish the following duties: ensure waste segregation and storage compatibility requirements are met; inspect and manage Satellite Accumulation areas; ensure only authorized personnel add wastes

to containers; ensure Contractor personnel are trained in 40 CFR requirements in accordance with their position requirements; coordinate removal of waste containers; and maintain the Environmental Records binder and required documentation, including environmental permits compliance and close-out. Submit Environmental Manager Qualifications to the Contracting Officer.

1.6.5 Employee Training Records

Prepare and maintain Employee Training Records throughout the term of the contract meeting applicable 40 CFR requirements. Provide Employee Training Records in the Environmental Records Binder. Ensure every employee completes a program of classroom instruction or on-the-job training that teaches them to perform their duties in a way that ensures compliance with federal, state and local regulatory requirements for RCRA Large Quantity Generator. Provide a Position Description for each employee, by subcontractor, based on the Davis-Bacon Wage Rate designation or other equivalent method, evaluating the employee's association with hazardous and regulated wastes. This Position Description will include training requirements as defined in 40 CFR 262.17 for a Large Quantity Generator facility. Submit these Assembled Employee Training Records to the Contracting Officer at the conclusion of the project, unless otherwise directed.

Train personnel to meet EPA and state requirements. Conduct environmental protection/pollution control meetings for personnel prior to commencing construction activities. Contact additional meetings for new personnel and when site conditions change. Include in the training and meeting agenda: Land Use Controls specified for Site 19 ON-SHORE DERECKTOR SHIPYARD, Operable Unit 12, in the NAVSTA Newport Record of Decision, September 2014 (see Attachment B); methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, waters of the United States, and endangered species and their habitat that are known to be in the area. Provide copy of the Erosion and Sediment Control Inspector Certification as required by the State of Rhode Island.

1.6.6 Non-Compliance Notifications

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with federal, state or local environmental laws or regulations, permits, and other elements of the Contractor's EPP. After receipt of such notice, inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. FAR 52.242-14 Suspension of Work provides that a suspension, delay, or interruption of work due to the fault or negligence of the Contractor allows for no adjustments to the contract for time extensions or equitable adjustments. In addition to a suspension of work, the Contracting Officer may use additional authorities under the contract or law.

1.7 ENVIRONMENTAL PROTECTION PLAN

The purpose of the EPP is to present an overview of known or potential

environmental issues that must be considered and addressed during construction. Incorporate construction related objectives and targets from the installation's EMS into the EPP. Include in the EPP measures for protecting natural and cultural resources, required reports, and other measures to be taken. Meet with the Contracting Officer or Contracting Officer Representative to discuss the EPP and develop a mutual understanding relative to the details for environmental protection including measures for protecting natural resources, required reports, and other measures to be taken. Submit the EPP within 15 days after Contract award and not less than 10 days before the preconstruction meeting. Revise the EPP throughout the project to include any reporting requirements, changes in site conditions, or contract modifications that change the project scope of work in a way that could have an environmental impact. No requirement in this section will relieve the Contractor of any applicable federal, state, and local environmental protection laws and regulations. During Construction, identify, implement, and submit for approval any additional requirements to be included in the EPP. Maintain the current version onsite.

The EPP includes, but is not limited to, the following elements:

1.7.1 General Overview and Purpose

1.7.1.1 Descriptions

A brief description of each specific plan required by environmental permit or elsewhere in this Contract such as stormwater management plan, spill control plan, solid waste management plan, wastewater management plan, air pollution control plan, contaminant prevention plan, a historical, archaeological, cultural resources, biological resources and wetlands plan, traffic control plan Hazardous, Toxic and Radioactive Waste (HTRW) Plan, Non-Hazardous Solid Waste Disposal Plan borrowing material plan, and marine mammal monitoring and hydroacoustic monitoring plan.

1.7.1.2 Duties

The duties and level of authority assigned to the person(s) on the job site who oversee environmental compliance, such as who is responsible for adherence to the EPP, who is responsible for spill cleanup and training personnel on spill response procedures, who is responsible for manifesting hazardous waste to be removed from the site, and who is responsible for training the Contractor's environmental protection personnel.

1.7.1.3 Procedures

A copy of any standard or project-specific operating procedures that will be used to effectively manage and protect the environment on the project site.

1.7.1.4 Communications

Communication and training procedures that will be used to convey environmental management requirements to Contractor employees and subcontractors.

1.7.1.5 Contact Information

Emergency contact information contact information (office phone number, cell phone number, and e-mail address).

1.7.2 General Site Information

1.7.2.1 Drawings

Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, jurisdictional wetlands, material storage areas, structures, sanitary facilities, storm drains and conveyances, and stockpiles of excess soil.

1.7.2.2 Work Area

Work area plan showing the proposed activity in each portion of the area and identify the areas of limited use or nonuse. Include measures for marking the limits of use areas, including methods for protection of features to be preserved within authorized work areas and methods to control runoff and to contain materials on site, and a traffic control plan.

1.7.2.3 Documentation

A letter signed by an officer of the firm appointing the Environmental Manager and stating that person is responsible for managing and implementing the Environmental Program as described in this contract. Include in this letter the Environmental Manager's authority to direct the removal and replacement of non-conforming work.

1.7.3 Management of Natural Resources

- a. Land resources
- b. Tree protection
- c. Replacement of damaged landscape features
- d. Temporary construction
- e. Stream crossings
- f. Fish and wildlife resources
- g. Wetland areas

1.7.4 Protection of Historical and Archaeological Resources

- a. Objectives
- b. Methods

1.7.5 Stormwater Management and Control

- a. Ground cover
- b. Erodible soils
- c. Temporary measures
 - (1) Structural Practices

(2) Temporary and permanent stabilization

- d. Effective selection, implementation and maintenance of Best Management Practices (BMPs).

1.7.6 Protection of the Environment from Waste Derived from Contractor Operations

Control and disposal of solid and sanitary waste. Control and disposal of hazardous waste.

This item consists of the management procedures for hazardous waste to be generated. The elements of those procedures will coincide with the Installation Hazardous Waste Management Plan. The Contracting Officer will provide a copy of the Installation Hazardous Waste Management Plan. As a minimum, include the following:

- a. List of the types of hazardous wastes expected to be generated
- b. Procedures to ensure a written waste determination is made for appropriate wastes that are to be generated
- c. Sampling/analysis plan, including laboratory method(s) that will be used for waste determinations and copies of relevant laboratory certifications
- d. Methods and proposed locations for hazardous waste accumulation/storage (that is, in tanks or containers)
- e. Management procedures for storage, labeling, transportation, and disposal of waste (treatment of waste is not allowed unless specifically noted)
- f. Management procedures and regulatory documentation ensuring disposal of hazardous waste complies with Land Disposal Restrictions (40 CFR 268)
- g. Management procedures for recyclable hazardous materials such as lead-acid batteries, used oil, and similar
- h. Used oil management procedures in accordance with 40 CFR 279; Hazardous waste minimization procedures
- i. Plans for the disposal of hazardous waste by permitted facilities; and Procedures to be employed to ensure required employee training records are maintained.

1.7.7 Prevention of Releases to the Environment

Procedures to prevent releases to the environment

Notifications in the event of a release to the environment

1.7.8 Regulatory Notification and Permits

List what notifications and permit applications must be made. Some permits require up to 180 days to obtain. Demonstrate that those permits have been obtained or applied for by including copies of the environmental permits. The EPP will not be approved until the permits have been

obtained.

1.7.9 Clean Air Act Compliance

1.7.9.1 Haul Route

Submit truck and material haul routes along with a Dirt and Dust Control Plan for controlling dirt, debris, and dust on Installation roadways. As a minimum, identify in the plan the subcontractor and equipment for cleaning along the haul route and measures to reduce dirt, dust, and debris from roadways.

1.7.9.2 Pollution Generating Equipment

Identify air pollution generating equipment or processes that may require federal, state, or local permits under the Clean Air Act. Determine requirements based on any current installation permits and the impacts of the project. Provide a list of all fixed or mobile equipment, machinery or operations that could generate air emissions during the project to the Installation Environmental Office (Air Program Manager).

1.7.9.3 Stationary Internal Combustion Engines

Identify portable and stationary internal combustion engines that will be supplied, used or serviced. Comply with 40 CFR 60 Subpart IIII, 40 CFR 60 Subpart JJJJ, 40 CFR 63 Subpart ZZZZ, and local regulations. At minimum, include the make, model, serial number, manufacture date, size (engine brake horsepower), and EPA emission certification status of each engine. Maintain records and log hours of operation and fuel use. Logs must include reasons for operation and delineate between emergency and non-emergency operation.

1.7.9.4 Refrigerants

Identify management practices to ensure that heating, ventilation, and air conditioning (HVAC) work involving refrigerants complies with 40 CFR 82 requirements. Technicians must be certified, maintain copies of certification on site, use certified equipment and log work that requires the addition or removal of refrigerant. Any refrigerant reclaimed is the property of the Government, coordinate with the Installation Environmental Office to determine the appropriate turn in location.

1.7.9.5 Air Pollution-engineering Processes

Identify planned air pollution-generating processes and management control measures (including, but not limited to, spray painting, abrasive blasting, demolition, material handling, fugitive dust, and fugitive emissions). Log hours of operations and track quantities of materials used.

1.7.9.6 Compliant Materials

Provide the Government a list of SDSs for all hazardous materials proposed for use on site. Materials must be compliant with all Clean Air Act regulations for emissions including solvent and volatile organic compound contents, and National Emission Standards for Hazardous Air Pollutants requirements. The Government may alter or limit use of specific materials as needed to meet installation permit requirements for emissions.

1.8 LICENSES AND PERMITS

Obtain licenses and permits required for the construction of the project and in accordance with FAR 52.236-7 Permits and Responsibilities. Notify the Government of all general use permitted equipment the Contractor plans to use on site. This paragraph supplements the Contractor's responsibility under FAR 52.236-7 Permits and Responsibilities.

a. The following permits have been obtained by the Government:

- (1) Order of Approval for a Marine Sewage Pumpout Facility Discharging to an Existing Sewer System
- (2) General Permit for Non-Contact Cooling Water (Hydrostatic test water)
- (3) Potable Water Service Application Form
- (4) General Permit for Stormwater Discharge Associated with Construction Activity (RIPDES) and Water Quality Certificate
- (5) Multi-Sector General Permit for Stormwater Discharge Associated with Industrial Activity
- (6) Incidental Harassment Authorization for Marine Mammals
- (7) Clean Water Act Section 404 Discharge of Dredged or Fill Material into Waters of the United States
- (8) Rivers and Harbors Act Section 10 Structure Affecting navigable waters of the United States
- (9) Clean Water Act Section 401 Water Quality Certification

For permits obtained by the Government, whether or not required by the permit, the Contractor is responsible for conforming to all permit requirements and performing all quality control inspections of the work in-progress, and to submit notifications and certifications to the regulatory agency for each via the Contracting Officer.

1.9 ENVIRONMENTAL RECORDS BINDER

Maintain on-site a separate three-ring Environmental Records Binder and submit at the completion of the project. Make separate parts within the binder that correspond to each submittal listed under paragraph CLOSEOUT SUBMITTALS in this section.

1.10 SOLID WASTE MANAGEMENT PERMIT

Provide the Contracting Officer with written notification of the quantity of anticipated solid waste or debris that is anticipated or estimated to be generated by construction. Include in the report the locations where various types of waste will be disposed or recycled. Include letters of acceptance from the receiving location; submit one copy of the receiving location state and local Solid Waste Management Permit or license showing such agency's approval of the disposal plan before transporting wastes off Government property.

1.10.1 Monthly Solid Waste Disposal Report

Monthly, submit a solid waste disposal report to the Contracting Officer. For each waste, the report will state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste.

1.11 FACILITY HAZARDOUS WASTE GENERATOR STATUS

Naval Station Newport is designated as a Large Quantity Generator. Meet the regulatory requirements of this generator designation for any work conducted within the boundaries of this Installation. Comply with provisions of federal, state, and local regulatory requirements applicable to this generator status regarding training and storage, handling, and disposal of construction derived wastes.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants, including their habitats. Prior to the commencement of activities, consult with the Installation Environmental Office, regarding rare species or sensitive habitats that need to be protected. The protection of rare, threatened, and endangered animal and plant species identified, including their habitats, is the Contractor's responsibility. The Contractor shall report to the Installation Environmental Office any injured or dead protected species discovered during work activities. The following species protected under the Endangered Species Act or Marine Mammal Protection Act that are known to occur in the area could be affected within the construction area: Atlantic sturgeon (*Acipenser oxyrinchus*), shortnose sturgeon (*Acipenser brevirostrum*); sea turtles (loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys kempii*), and green (*Chelonia mydas*)); marine mammals (Atlantic white-sided dolphin (*Legionorhynchus acutus*), short-beaked common dolphin (*Delphinus delphis*), harbor porpoise (*Phocoena phocoena*), harbor seal (*Phoca vitulina*), gray seal (*Halichoerus grypus atlantica*), harp seal (*Pagophilus groenlandicus*); and hooded seal (*Crystphora cristata*)).

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work that is consistent with the requirements of the Installation Environmental Office or as otherwise specified. Confine construction activities to within the limits of the work indicated or specified.

3.1.1 Flow Ways

Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as specified and permitted.

3.1.2 Vegetation

Except in areas to be cleared, do not remove, cut, deface, injure, or

destroy trees or shrubs without the Contracting Officer's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the Contracting Officer. Where such use of attached ropes, cables, or guys is authorized, the Contractor is responsible for any resultant damage.

Protect existing trees that are to remain to ensure they are not injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas. Coordinate with the Contracting Officer and Installation Environmental Office to determine appropriate action for trees and other landscape features scarred or damaged by equipment operations.

3.1.3 Streams

Stream crossings must allow movement of materials or equipment without violating water pollution control standards of the federal, state, and local governments. Construction of stream crossing structures must be in compliance with any required permits including, but not limited to, Clean Water Act Section 404, and Section 401 Water Quality.

The Contracting Officer's approval and appropriate permits are required before any equipment will be permitted to ford live streams. In areas where frequent crossings are required, install temporary culverts or bridges. Obtain Contracting Officer's approval prior to installation. Remove temporary culverts or bridges upon completion of work, and repair the area to its original condition unless otherwise required by the Contracting Officer.

3.1.4 Marine Wildlife

Comply with the requirements of the National Marine Fisheries Service Incidental Harassment Authorization specifying Marine Mammal Monitoring and Hydroacoustic Monitoring intended to limit take of marine mammals and to reduce the risks of exposing marine mammals to dangerous levels of underwater noise.

Conduct impact pile driving during daylight hours in conditions that allow marine mammal observation. Impact pile-driving activities must utilize a "soft-start" to allow marine mammals and other sensitive species to move away from the noise source before the commencement of pile-driving. A soft-start procedure must be used for impact pile-driving at the beginning of each day's in-water pile-driving or any time impact pile-driving has ceased for more than 30 minutes. Provide an initial set of strikes from the impact hammer at reduced energy, followed by a 30-sec waiting period, then two subsequent sets.

3.2 STORMWATER

Do not discharge stormwater from construction sites to the sanitary sewer. If the water is noted or suspected of being contaminated, it may only be released to the storm drain system if the discharge is specifically permitted. Obtain authorization in advance from the Installation Environmental Office for any release of contaminated water.

3.2.1 Construction General Permit

Provide a Construction General Permit as required by 40 CFR 122.26 or the State of Rhode Island General Permit. Under the terms and conditions of

the permit, install, inspect, maintain BMPs, prepare stormwater erosion and sediment control inspection reports, and submit SMP inspection reports. Maintain construction operations and management in compliance with the terms and conditions of the general permit for stormwater discharges from construction activities.

3.2.1.1 Stormwater Management Plan

Submit a project-specific Stormwater Management Plan (SMP) to the Contracting Officer for approval, within 30 days of Contract Award and prior to the commencement of work (See Attachment B Stormwater Management Plan with draft Notice of Intent). The SMP must meet the requirements of 40 CFR 122.26 and the State of Rhode Island General Permit for stormwater discharges from construction sites.

Include the following:

- a. Comply with terms of the Rhode Island general permit for stormwater discharges from construction activities. Prepare SMP in accordance with Rhode Island requirements. Use Rhode Island SMP Guidance located at <http://www.dem.ri.gov/programs/benviron/water/permits/swcoord/pdf/swmpguid.pdf> to prepare the SMP.
- b. Select applicable BMPs from EPA Fact Sheets located at <https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater#constr> or in accordance with state or local requirements.
- c. Include a completed copy of the Notice of Intent, BMP Inspection Report Template, and Stormwater Notice of Termination, except for the effective date (See Attachment B Stormwater Management Plan with draft Notice of Intent).

3.2.1.2 Stormwater Notice of Intent for Construction Activities

Prepare and submit the Notice of Intent for NPDES coverage under the general permit for construction activities to the Contracting Officer for review and approval (See Attachment B Stormwater Management Plan with draft Notice of Intent).

Submit the approved NOI and appropriate permit fees to Rhode Island Department of Environmental Management (RIDEM). No land disturbing activities may commence without permit coverage. Maintain an approved copy of the SWPPP at the onsite construction office, and continually update as regulations require, reflecting current site conditions.

3.2.1.3 Inspection Reports

Submit "Inspection Reports" to the Contracting Officer in accordance with the State of Rhode Island Construction General Permit.

3.2.1.4 Stormwater Management Plan Compliance Notebook

Create and maintain a three ring binder of documents that demonstrate compliance with the Construction General Permit. Include a copy of the permit Notice of Intent, proof of permit fee payment, SWPPP and SWPPP update amendments, inspection reports and related corrective action records, copies of correspondence with the RIDEM and Rhode Island Coastal

Resources Council, and a copy of the permit Notice of Termination in the binder. At project completion, the notebook becomes property of the Government. Provide the compliance notebook to the Contracting Officer.

3.2.1.5 Stormwater Notice of Termination for Construction Activities

Submit a Notice of Termination to the Contracting Officer for approval once construction is complete and final stabilization has been achieved on all portions of the site for which the permittee is responsible. Once approved, submit the Notice of Termination to RIDEM. Prepare as-built topographic survey information required by the permitting agency for certification of the stormwater management system, and provide to the Contracting Officer.

3.2.2 Erosion and Sediment Control Measures

Provide erosion and sediment control measures in accordance with state and local laws and regulations. Preserve vegetation to the maximum extent practicable.

Erosion control inspection reports may be compiled as part of the SMP inspection reports.

3.2.2.1 Erosion Control

Prevent erosion by composite filter tubes or straw wattles, silt fence conforming to Rhode Island Erosion and Sediment Control Handbook, mulching, and Geotextiles. Stabilize slopes by composite filter tubes or straw wattles, sodding, seeding, mulching, or such combination of these methods necessary for effective erosion control. Use of hay bales is prohibited.

Provide seeding in accordance with Section 32 92 19 SEEDING.

3.2.2.2 Sediment Control Practices

Implement sediment control practices to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Implement sediment control practices prior to soil disturbance and prior to creating areas with concentrated flow, during the construction process to minimize erosion and sediment laden runoff. Include the following devices: silt fence, storm drain inlet protection, temporary sediment tanks for all temporary construction dewatering discharges. Location and details of installation and construction are indicated on the drawings.

3.2.3 Work Area Limits

Mark the areas that need not be disturbed under this Contract prior to commencing construction activities. Mark or fence isolated areas within the general work area that are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers must be visible in the dark. Personnel must be knowledgeable of the purpose for marking and protecting particular objects.

3.2.4 Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the

Contracting Officer. Move or relocate the Contractor facilities only when approved by the Government. Provide erosion and sediment controls for onsite borrow and spoil areas to prevent sediment from entering nearby waters. Control temporary excavation and embankments for plant or work areas to protect adjacent areas.

3.2.5 Municipal Separate Storm Sewer System (MS4) Management

Comply with the Installation's MS4 permit requirements.

3.3 SURFACE AND GROUNDWATER

3.3.1 Cofferdams, Diversions, and Dewatering

Construction operations for dewatering, removal of cofferdams, tailrace excavation, and tunnel closure must be constantly controlled to maintain compliance with existing state water quality standards and designated uses of the surface water body. Comply with the State of Rhode Island water quality standards and anti-degradation provisions and the Clean Water Act Section 404 General Permit for the State of Rhode Island. Discharge of ground water is prohibited. Do not discharge excavation ground water to the sanitary sewer, storm drains, or to surface waters. All ground water is to be collected into frac tanks and disposed of offsite in accordance with state regulations and specification 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL. Discharge of hazardous substances will not be permitted under any circumstances. Use sediment control BMPs to prevent construction site runoff from directly entering any storm drain or surface waters.

Obtain authorization for any contaminated groundwater disposal in advance from the Installation Environmental Officer and the federal or state authority, as applicable. Discharge of hazardous substances will not be permitted under any circumstances.

3.3.2 Waters of the United States

Do not enter, disturb, destroy, or allow discharge of contaminants into waters of the United States except as authorized herein. The protection of waters of the United States shown on the drawings in accordance with paragraph LICENSES AND PERMITS is the Contractor's responsibility. Authorization to enter specific waters of the United States identified does not relieve the Contractor from any obligation to protect other waters of the United States within, adjacent to, or in the vicinity of the construction site and associated boundaries.

3.4 PROTECTION OF CULTURAL RESOURCES

3.4.1 Archaeological Resources

If, during excavation or other construction activities, any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, activities that may damage or alter such resources will be suspended. Resources covered by this paragraph include, but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to

their significance and what, if any, special disposition of the finds should be made. Cease all activities that may result in impact to or the destruction of these resources. Secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources. The Government retains ownership and control over archaeological resources.

3.4.2 Historical Resources

Existing historical resources adjacent to the work area are shown on the drawings. Protect these resources and be responsible for their preservation during the life of the Contract.

3.5 AIR RESOURCES

Equipment operation, activities, or processes will be in accordance with 40 CFR 64 and state air emission and performance laws and standards.

3.5.1 Preconstruction Air Permits

Notify the Air Program Manager, through the Contracting Officer, at least 6 months prior to bringing equipment, assembled or unassembled, onto the Installation, so that air permits can be secured. Necessary permitting time must be considered in regard to construction activities. Clean Air Act (CAA) permits must be obtained prior to bringing equipment, assembled or unassembled, onto the Installation. For internal combustion engines, ensure units are equipped with non-resettable hour meters and submit the EPA emission certification to the Air Program Manager.

Confirm that these permits have been obtained.

3.5.2 Oil or Dual-fuel Boilers and Furnaces

Provide product data and details for new, replacement, or relocated fuel fired boilers, heaters, or furnaces to the Installation Environmental Office (Air Program Manager) through the Contracting Officer. Data to be reported include: equipment purpose (water heater, building heat, process), manufacturer, model number, serial number, fuel type (oil type, gas type) size (MMBTU heat input). Provide in accordance with paragraph PRECONSTRUCTION AIR PERMITS.

3.5.3 Burning

Burning is prohibited on the Government premises.

3.5.4 Class I and II ODS Prohibition

Class I and II ODS are Government property and must be returned to the Government for appropriate management. Coordinate with the Installation Environmental Office to determine the appropriate location for turn in of all reclaimed refrigerant.

3.5.5 Accidental Venting of Refrigerant

Accidental venting of a refrigerant is a release and must be reported immediately to the Contracting Officer.

3.5.6 EPA Certification Requirements

Heating and air conditioning technicians must be certified through an EPA-approved program. Maintain copies of certifications at the employees' places of business; technicians must carry certification wallet cards, as provided by environmental law.

3.5.7 Dust Control

Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations in conformance with Rhode Island Erosion and Sediment Control Handbook. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster. Since these products contain Crystalline Silica, comply with the OSHA standard, 29 CFR 1910.1053 or 29 CFR 1926.1153 for controlling exposure to Crystalline Silica Dust.

3.5.7.1 Particulates

Dust particles, aerosols and gaseous by-products from construction activities, and processing and preparation of materials (such as from asphaltic batch plants) must be controlled at all times, including weekends, holidays, and hours when work is not in progress. Maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates that would exceed 40 CFR 50, state, and local air pollution standards or that would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators, or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp. Provide sufficient, competent equipment available to accomplish these tasks. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs. Comply with state and local visibility regulations.

3.5.7.2 Abrasive Blasting

Blasting operations cannot be performed without prior approval of the Installation Air Program Manager. The use of silica sand is prohibited in sandblasting.

Provide tarpaulin drop cloths and windscreens to enclose abrasive blasting operations to confine and collect dust, abrasive agent, paint chips, and other debris. Perform work involving removal of hazardous material in accordance with 29 CFR 1910.

3.5.8 Odors

Control odors from construction activities. The odors must be in compliance with state regulations and local ordinances and may not constitute a health hazard.

3.6 WASTE MINIMIZATION

Minimize the use of hazardous materials and the generation of waste. Include procedures for pollution prevention/ hazardous waste minimization in the Hazardous Waste Management Section of the EPP. Obtain a copy of the installation's Pollution Prevention/Hazardous Waste Minimization Plan for reference material when preparing this part of the EPP. If no written plan exists, obtain information by contacting the Contracting Officer. Describe the anticipated types of the hazardous materials to be used in the construction when requesting information.

3.6.1 Salvage, Reuse and Recycle

Identify anticipated materials and waste for salvage, reuse, and recycling. Describe actions to promote material reuse, resale or recycling. To the extent practicable, all scrap metal must be sent for reuse or recycling and will not be disposed of in a landfill.

Include the name, physical address, and telephone number of the hauler, if transported by a franchised solid waste hauler. Include the destination and, unless exempted, provide a copy of the state or local permit (cover) or license for recycling.

3.6.2 Nonhazardous Solid Waste Diversion Report

Maintain an inventory of nonhazardous solid waste diversion and disposal of construction and demolition debris. Submit a report to the Contracting Officer on the first working day after each fiscal year quarter, starting the first quarter that nonhazardous solid waste has been generated. Include the following in the report:

Construction and Demolition (C&D) Debris Disposed	as appropriate
C&D Debris Recycled	as appropriate
C&D Debris Composted	as appropriate
Total C&D Debris Generated	as appropriate
Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount)	as appropriate

3.7 WASTE MANAGEMENT AND DISPOSAL

3.7.1 Waste Determination Documentation

Complete a Waste Determination form (provided at the pre-construction conference) for Contractor-derived wastes to be generated. All potentially hazardous solid waste streams that are not subject to a specific exclusion or exemption from the hazardous waste regulations (e.g. scrap metal, domestic sewage) or subject to special rules, (lead-acid batteries and precious metals) must be characterized in accordance with the requirements of 40 CFR 261 or corresponding applicable state or local regulations. Base waste determination on user knowledge of the processes and materials used, and analytical data when necessary. Consult with the Installation environmental staff for guidance on specific requirements. Attach support documentation to the Waste Determination form. As a minimum, provide a Waste Determination form for the following waste (this listing is not inclusive): oil- and latex -based painting and caulking products, solvents, adhesives, aerosols, petroleum products, surplus soil,, and containers of the original materials.

3.7.1.1 Sampling and Analysis of Waste

3.7.1.1.1 Waste Sampling

Sample waste in accordance with EPA SW-846. Clearly mark each sampled drum or container with the Contractor's identification number, and cross reference to the chemical analysis performed.

3.7.1.1.2 Laboratory Analysis

Follow the analytical procedure and methods in accordance with the 40 CFR 261. Provide analytical results and reports performed to the Contracting Officer.

3.7.1.1.3 Analysis Type

Identify hazardous waste by analyzing for the following characteristics: ignitability, corrosivity, reactivity, toxicity based on TCLP results, and additional sampling required by the CERCLA Work Plan, Newport Soil Management Determination, and receiving disposal facility requirements.

3.7.2 Solid Waste Management

3.7.2.1 Project Solid Waste Disposal Documentation Report

Provide copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, a statement indicating the disposal location for the solid waste that is signed by an employee authorized to legally obligate or bind the firm may be submitted. The sales documentation must include the receiver's tax identification number and business, EPA or state registration number, along with the receiver's delivery and business addresses and telephone numbers. For each solid waste retained for the Contractor's own use, submit the information previously described in this paragraph on the solid waste disposal report. Prices paid or received do not have to be reported to the Contracting Officer unless required by other provisions or specifications of this Contract or public law.

3.7.2.2 Control and Management of Solid Wastes

Pick up solid wastes, and place in covered containers that are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Employ segregation measures so that no hazardous or toxic waste will become co-mingled with non-hazardous solid waste.

Transport solid waste, except excavated soil designated for on-site reuse as allowed per Attachment B - Table 1 Soil/Sediment Management Determination for Naval Station, Newport, Rhode Island, and meeting specifications for intended use pursuant to Section 31 23 00.00 20 EXCAVATION AND FILL, off Government property and dispose of it in compliance with 40 CFR 260, state, and local requirements for solid waste disposal. A Subtitle D RCRA permitted landfill is the minimum acceptable offsite solid waste disposal option. Verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate. Segregate and separate treated wood components disposed at a lined landfill approved to accept this waste in accordance with local and state regulations. Solid waste disposal offsite must comply with most stringent local, state, and federal requirements, including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

Manage hazardous material used in construction, including but not limited to, aerosol cans, waste paint, cleaning solvents, contaminated brushes, and used rags, in accordance with 49 CFR 173.

3.7.3 Control and Management of Hazardous Waste

Do not dispose of hazardous waste on Government property. Do not discharge any waste to a sanitary sewer, storm drain, or to surface waters or conduct waste treatment or disposal on Government property without written approval of the Contracting Officer.

3.7.3.1 Hazardous Waste/Debris Management

Identify construction activities that will generate hazardous waste or debris. Provide a documented waste determination for resultant waste streams. Identify, label, handle, store, and dispose of hazardous waste or debris in accordance with federal, state, and local regulations,

including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268.

Manage hazardous waste in accordance with the approved Hazardous Waste Management Section of the EPP. Store hazardous wastes in approved containers in accordance with 49 CFR 173 and 49 CFR 178. Hazardous waste generated within the confines of Government facilities is identified as being generated by the Government. Prior to removal of any hazardous waste from Government property, hazardous waste manifests must be signed by personnel from the Installation Environmental Office. Do not bring hazardous waste onto Government property. Provide the Contracting Officer with a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-SUBPART D.

3.7.3.2 Waste Storage/Satellite Accumulation/90 Day Storage Areas

Accumulate hazardous waste at satellite accumulation points and in compliance with 40 CFR 262.34 and applicable state or local regulations. Individual waste streams will be limited to 55 gallons of accumulation (or 1 quart for acutely hazardous wastes). If the Contractor expects to generate hazardous waste at a rate and quantity that makes satellite accumulation impractical, the Contractor may request a temporary 90 day accumulation point be established. Submit a request in writing to the Contracting Officer and provide the following information (Attach Site Plan to the Request):

Contract Number	_____
Contractor	_____
Haz/Waste or Regulated Waste POC	_____
Phone Number	_____
Type of Waste	_____
Source of Waste	_____
Emergency POC	_____
Phone Number	_____
Location of the Site	_____

Attach a Waste Determination form for the expected waste streams. Allow 10 working days for processing this request. Additional compliance requirements (e.g. training and contingency planning) that may be required are the responsibility of the Contractor. Barricade the designated area where waste is being stored and post a sign identifying as follows:

"DANGER - UNAUTHORIZED PERSONNEL KEEP OUT"

3.7.3.3 Hazardous Waste Disposal

3.7.3.3.1 Responsibilities for Contractor's Disposal

Provide hazardous waste manifest to the Installations Environmental Office for review, approval, and signature prior to shipping waste off Government property.

3.7.3.3.1.1 Services

Provide service necessary for the final treatment or disposal of the hazardous material or waste in accordance with 40 CFR 260, local, and state, laws and regulations, and the terms and conditions of the Contract within 60 days after the materials have been generated. These services include necessary personnel, labor, transportation, packaging, detailed analysis (if required for disposal or transportation, include manifesting or complete waste profile sheets, equipment, and compile documentation).

3.7.3.3.1.2 Samples

Obtain a representative sample of the material generated for each job done to provide waste stream determination.

3.7.3.3.1.3 Analysis

Analyze each sample taken and provide analytical results to the Contracting Officer. See paragraph WASTE DETERMINATION DOCUMENTATION.

3.7.3.3.1.4 Labeling

Determine the Department of Transportation's (DOT's) proper shipping names for waste (each container requiring disposal) and demonstrate to the Contracting Officer how this determination is developed and supported by the sampling and analysis requirements contained herein. Label all containers of hazardous waste with the words "Hazardous Waste" or other words to describe the contents of the container in accordance with 40 CFR 262.31 and applicable state or local regulations.

3.7.3.3.2 Contractor Disposal Turn-In Requirements

Hazardous waste generated must be disposed of in accordance with the following conditions to meet installation requirements:

- a. Drums must be compatible with waste contents and drums must meet DOT requirements for 49 CFR 173 for transportation of materials.
- b. Band drums to wooden pallets.
- c. No more than three 55 gallon drums or two 85 gallon over packs are to be banded to a pallet.
- d. Band using 1-1/4 inch minimum band on upper third of drum.
- e. Provide label in accordance with 49 CFR 172.101.
- f. Leave 3 to 5 inches of empty space above volume of material.

3.7.3.4 Universal Waste Management

Manage the following categories of universal waste in accordance with federal, state, and local requirements and installation instructions:

- a. Batteries as described in 40 CFR 273.2
- b. Lamps as described in 40 CFR 273.5

c. Mercury-containing equipment as described in 40 CFR 273.4

Mercury is prohibited in the construction of this facility, unless specified otherwise, and with the exception of mercury vapor lamps and fluorescent lamps. Dumping of mercury-containing materials and devices such as mercury vapor lamps, fluorescent lamps, and mercury switches, in rubbish containers is prohibited. Remove without breaking, pack to prevent breakage, and transport out of the activity in an unbroken condition for disposal as directed.

3.7.3.5 Electronics End-of-Life Management

Recycle or dispose of electronics waste, including, but not limited to, used electronic devices such computers, monitors, hard-copy devices, televisions, mobile devices, in accordance with 40 CFR 260-262, state, and local requirements, and installation instructions.

3.7.3.6 Disposal Documentation for Hazardous and Regulated Waste

Contact the Contracting Officer for the facility RCRA identification number that is to be used on each manifest.

Submit a copy of the applicable EPA and or state permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities. Hazardous or toxic waste manifests must be reviewed, signed, and approved by the Contracting Officer before the Contractor may ship waste. To obtain specific disposal instructions, coordinate with the Installation Environmental Office.

3.7.4 Releases/Spills of Oil and Hazardous Substances

3.7.4.1 Response and Notifications

Exercise due diligence to prevent, contain, and respond to spills of hazardous material, hazardous substances, hazardous waste, sewage, regulated gas, petroleum, lubrication oil, and other substances regulated in accordance with 40 CFR 300. Maintain spill cleanup equipment and materials at the work site. In the event of a spill, take prompt, effective action to stop, contain, curtail, or otherwise limit the amount, duration, and severity of the spill/release. In the event of any releases of oil and hazardous substances, chemicals, or gases; immediately (within 15 minutes) notify the Installation Fire Department, the Installation Command Duty Officer, the Installation Environmental Office, and the Contracting Officer.

Submit verbal and written notifications as required by the federal (40 CFR 300.125 and 40 CFR 355), state, local regulations and instructions. Provide copies of the written notification and documentation that a verbal notification was made within 20 days. Spill response must be in accordance with 40 CFR 300 and applicable state and local regulations. Contain and clean up these spills without cost to the Government.

3.7.4.2 Clean Up

Clean up hazardous and non-hazardous waste spills. Reimburse the Government for costs incurred including sample analysis materials, clothing, equipment, and labor if the Government will initiate its own spill cleanup procedures, for Contractor- responsible spills, when: Spill

cleanup procedures have not begun within one hour of spill discovery/occurrence; or, in the Government's judgment, spill cleanup is inadequate and the spill remains a threat to human health or the environment.

3.7.5 Mercury Materials

Immediately report to the Environmental Office and the Contracting Officer instances of breakage or mercury spillage. Clean mercury spill area to the satisfaction of the Contracting Officer.

Do not recycle a mercury spill cleanup; manage it as a hazardous waste for disposal.

3.7.6 Wastewater

3.7.6.1 Disposal of Wastewater

Disposal of wastewater must be as specified below.

3.7.6.1.1 Treatment

Do not allow wastewater from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, and forms to enter water ways or to be discharged prior to being treated to remove pollutants. Dispose of the construction- related waste water by collecting and placing it in a retention pond where suspended material can be settled out or the water can evaporate to separate pollutants from the water. The site for the retention pond must be coordinated and approved with the Contracting Officer. The residue left in the pond prior to completion of the project must be removed, tested, and disposed of off- Government property in accordance with federal, state, and local laws and regulations. Backfill the area to the original grade, top-soiled, and seeded or sodded. Test the water in the retention pond for RCRA metals, volatile organic chemicals (VOCs), Semi-volatile VOCs, total petroleum hydrocarbons (TPH), and have the results reviewed and approved by the Contracting Officer prior to being discharged in accordance with project permits or disposed of off- Government property.

3.7.6.1.2 Surface Discharge

Discharge of ground water is prohibited. All ground water is to be collected into frac tanks and disposed of offsite in accordance with state regulations.

3.7.6.1.3 Land Application

Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing must be discharged into the sanitary sewer with prior approval and notification to the Wastewater Treatment Plant's Operator.

3.8 HAZARDOUS MATERIAL MANAGEMENT

Include hazardous material control procedures in the Safety Plan, in accordance with Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS. Address procedures and proper handling of hazardous materials, including the appropriate transportation requirements. Do not bring hazardous

material onto Government property that does not directly relate to requirements for the performance of this contract. Submit an SDS and estimated quantities to be used for each hazardous material to the Contracting Officer prior to bringing the material on the installation. Typical materials requiring SDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum products. Use hazardous materials in a manner that minimizes the amount of hazardous waste generated. Containers of hazardous materials must have National Fire Protection Association labels or their equivalent. Certify that hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste, in accordance with 40 CFR 261.

The Contractor shall identify what wastes are hazardous using specific and technical knowledge and/or sampling and analysis.

Hazardous waste includes, but is not limited to:

1. Fuels and oils of all types
2. Asbestos (asbestos-contaminated land survey required in all Navy Installation Restoration (IR) areas).

3.8.1 Contractor Hazardous Material Inventory Log

Submit the "Contractor Hazardous Material Inventory Log"(found at: <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>), which provides information required by (EPCRA Sections 312 and 313) along with corresponding SDS, to the Contracting Officer at the start and at the end of construction (30 days from final acceptance), and update no later than January 31 of each calendar year during the life of the contract. Keep copies of the SDSs for hazardous materials onsite. At the end of the project, provide the Contracting Officer with copies of the SDSs, and the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the project, and how the material was used.

The Contracting Officer may request documentation for any spills or releases, environmental reports, or off-site transfers.

3.9 PREVIOUSLY USED EQUIPMENT

Clean previously used construction equipment prior to bringing it onto the project site. Equipment must be free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. Consult with the U.S. Department of Agriculture jurisdictional office for additional cleaning requirements.

3.10 CONTROL AND MANAGEMENT OF ASBESTOS-CONTAINING MATERIAL (ACM)

Manage and dispose of asbestos- containing waste in accordance with 40 CFR 61, Rhode Island Rules and Regulations for Asbestos Control (R23-24.5-ASB) and all federal, state, and local requirements. Manifest asbestos-containing waste and provide the manifest to the Contracting Officer. Notifications to the state and Installation Air Program Manager are required before starting any asbestos work.

3.11 CONTROL AND MANAGEMENT OF LEAD-BASED PAINT (LBP)

Manage and dispose of lead-contaminated waste in accordance with 40 CFR 745. Manifest any lead-contaminated waste and provide the manifest to the Contracting Officer.

3.12 CONTROL AND MANAGEMENT OF POLYCHLORINATED BIPHENYLS (PCBS)

Manage and dispose of PCB-contaminated waste in accordance with 40 CFR 761.

3.13 MILITARY MUNITIONS

In the event military munitions, as defined in 40 CFR 260, are discovered or uncovered, immediately stop work in that area and immediately inform the Contracting Officer.

3.14 PETROLEUM, OIL, LUBRICANT (POL) STORAGE AND FUELING

POL products include flammable or combustible liquids, such as gasoline, diesel, lubricating oil, used engine oil, hydraulic oil, mineral oil, and cooking oil. Store POL products and fuel equipment and motor vehicles in a manner that affords the maximum protection against spills into the environment. Manage and store POL products in accordance with EPA 40 CFR 112, and other federal, state, regional, and local laws and regulations. Use secondary containments, dikes, curbs, and other barriers, to prevent POL products from spilling and entering the ground, storm or sewer drains, stormwater ditches or canals, or navigable waters of the United States. Describe in the EPP (see paragraph ENVIRONMENTAL PROTECTION PLAN) how POL tanks and containers must be stored, managed, and inspected and what protections must be provided. Storage of oil, including fuel, on the project site is not allowed. Fuel must be brought to the project site each day that work is performed.

3.14.1 Used Oil Management

Manage used oil generated on site in accordance with 40 CFR 279. Determine if any used oil generated while onsite exhibits a characteristic of hazardous waste. Used oil containing 1,000 parts per million of solvents is considered a hazardous waste and disposed of at the Contractor's expense. Used oil mixed with a hazardous waste is also considered a hazardous waste. Dispose in accordance with paragraph HAZARDOUS WASTE DISPOSAL.

3.14.2 Oil Storage Including Fuel Tanks

Storage of oil, including fuel, on the project site is not allowed. Fuel must be brought to the project site each day that work is performed.

Monitor and remove any rainwater that accumulates in open containment dikes or berms. Inspect the accumulated rainwater prior to draining from a containment dike to the environment, to determine there is no oil sheen present.

3.15 INADVERTENT DISCOVERY OF PETROLEUM-CONTAMINATED SOIL OR HAZARDOUS WASTES

If petroleum-contaminated soil, or suspected hazardous waste is found during construction that was not identified in the Contract documents, immediately notify the Contracting Officer. Do not disturb this material

until authorized by the Contracting Officer.

3.16 CHLORDANE

Evaluate excess soils and concrete foundation debris generated during the demolition of housing units or other wooden structures for the presence of chlordane or other pesticides prior to reuse or final disposal.

3.17 SOUND INTRUSION

Make the maximum use of low-noise emission products, as certified by the EPA. Blasting or use of explosives are not permitted without written permission from the Contracting Officer, and then only during the designated times. Confine pile-driving operations to daylight hours, typically the period between 7 a.m. and 5 p.m., Monday through Friday, exclusive of holidays, unless otherwise specified.

Keep construction activities under surveillance and control to minimize environment damage by noise. Comply with the provisions of the State of Rhode Island rules and the National Marine Fisheries Service Incidental Harassment Authorization for incidental take of marine mammals, which specifies Marine Mammal Monitoring and Hydroacoustic Monitoring requirements.

3.18 POST CONSTRUCTION CLEANUP

Clean up areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing by the Contracting Officer, remove traces of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. Grade parking area and similar temporarily used areas to conform with surrounding contours.

3.19 ENVIRONMENTAL GUIDANCE FOR INSTALLATION RESTORATION PROGRAM (IRP) AND NON-IRP AREAS

Contractor must adhere to the following (see Specification Attachment B - SECTION 01 57 19 ATTACHMENTS - ENVIRONMENTAL GUIDANCE DOCUMENTS):

1. Record of Decision. Site 19 - Former Derecktor Shipyard Marine Sediment, Operable Unit 5, Naval Station Newport, Middletown/Newport, Rhode Island. (September 2014)
 2. Record of Decision. Site 19 - On-Shore Derecktor Shipyard Soil and Groundwater (Operable Unit 12), Naval Station Newport, Middletown/Newport, Rhode Island. (September 2014)
 3. Land Use Control Remedial Design for Site 19-former Derecktor Shipyard Operable Units 5 and 12, Naval Station Newport, (March 2016)
 4. Table 1. Soil/Sediment Management Determination for Naval Station, Newport, Rhode Island (20June2022)
 5. Stormwater Management Plan (March 2022)
- End of Section --

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SECTION 01 57 19.01 20

SUPPLEMENTAL TEMPORARY ENVIRONMENTAL CONTROLS
11/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. If state or local references are not provided here, refer to Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS for appropriate references.

ASTM INTERNATIONAL (ASTM)

ASTM E2356 (2018) Standard Practice for Comprehensive Building Asbestos Surveys

Rhode Island Department of Environmental Management (RIDEM)

DEM-DSR-01-93 Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases, Short Title: Remediation Regulations

RHODE ISLAND DEPARTMENT OF HEALTH

R23-24.5-ASB Rules and Regulations for Asbestos Control

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 261 Identification and Listing of Hazardous Waste

40 CFR 262 Standards Applicable to Generators of Hazardous Waste

40 CFR 265 Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Regulatory Notifications; G

SD-06 Test Reports

Laboratory Analysis

Inspection Reports

SD-11 Closeout Submittals

Closure Reports

Waste Determination Documentation; G

Disposal Documentation for Hazardous and Regulated Waste; G

Annual Notifications (performed by Navy)

Annual Reports (performed by Navy)

1.3 MID-ATLANTIC

Comply with the following state, regional, and local requirements which supplement Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.

1.3.1 Rhode Island

1.3.1.1 Definition and Disposal Requirements of Empty Paint Cans

Paint Cans: Paint cans that meet the definition of Resource Conservation and Recovery Act (RCRA) empty (40 CFR 261) of paints, solvents, thinners and adhesives may be disposed of in dumpsters.

Metal paint cans that meet the empty standard can be placed in dumpsters marked "metal only"; plastic cans may be placed in solid waste dumpsters. Manage paint cans with liquid or more than one inch of solidified oil-based paint as a hazardous waste and label properly. Manage paint cans with excess water-based paint as non-hazardous waste. Contact NAVSTA Newport Environmental Office for management requirements.

1.3.1.2 Construction Dewatering

Construction site stormwater runoff must be treated using proper erosion control measures or stormwater management practices prior to release from the construction site. Pollutants, including but not limited to chemicals, fuels, lubricants, sewage, paints, sedimentation, and other harmful materials must not be discharged into or alongside any river, stream, or impoundment, or into any channels leading to them. Implement appropriate erosion and sediment control measures to all disturbed areas or bare soils to prevent unauthorized offsite sedimentation. Apply stabilization measures to denuded portions of a project that are at final grade or where work has temporarily ceased within 7 days.

1.3.1.3 Asbestos Abatement and Notification Procedures

Structures must be surveyed for the presence of asbestos prior to demolition or renovation. A structure is defined as including any load-bearing portion of a structure. The survey must be performed by a licensed, certified, accredited asbestos inspector in accordance with ASTM E2356.

A licensed asbestos abatement contractor shall utilize the most current revision of the Rhode Island Department of Health, Division of Occupational and Radiological Health Form ASB-22 for written notification at least ten (10) working days before beginning any on-site work at a

planned asbestos abatement project that involves the removal, encapsulation, enclosure, renovation, repair, demolition, or other disturbance of friable asbestos containing material in compliance with R23-24.5-ASB. Provide copies of notifications to the environmental office (Air Manager) through the Contracting Officer prior to beginning work. Make notifications for any project that includes asbestos abatement (and for all demolition projects, regardless of whether asbestos containing materials are present in the structure or facility) in accordance with paragraph DEMOLITION. Notification is not required if asbestos is nonfriable asbestos containing roofing, flooring, or siding materials that when installed, encapsulated, or removed do not become friable. If the material is damaged, the matrix binding the asbestos fibers has deteriorated, or mechanical removal results in more-than-incidental breakage, then notification is required. Activities such as grinding, mechanical chipping, sawing, or drilling can make the asbestos containing material friable and would require notification.

1.3.1.3.1 Best Management Practices

Use BMPs to ensure EPA requirements are met, including: preventing airborne emissions via wetting asbestos prior to removal; using glove bags or containment; using HEPA-filtered vacuum or ventilation systems; restricting access to asbestos-control areas until thoroughly cleaned and inspected, and acceptable air-samples have been received. Consideration should be given to other environmental program requirements such as Clean Water Act (CWA) requirements when making decisions regarding BMPs.

1.3.1.3.2 Asbestos Waste Disposal

Prior to asbestos waste disposal, phone the NAVSTA Newport asbestos program manager and Environmental Office. A manifest must be signed by this office prior to waste being removed from the installation. Provide copies of manifests and notifications to the contracting officer to provide to the Installation hazardous Waste and asbestos program managers.

1.3.1.4 Hazardous Waste Requirements for Rhode Island Installations:

1.3.1.4.1 Demolition

Remove the following items from the site prior to demolition: polychlorinated biphenyls (PCBs), fluorescent bulbs, mercury and metal components (such as furnaces, ducts, and piping), and any hazardous materials. Manage lead, fluorescent bulbs, mercury-containing equipment, and any other waste as "hazardous or universal waste" as appropriate (see paragraph HAZARDOUS AND UNIVERSAL WASTE GENERATION). If the demolition activity encompasses the whole building (the building must be demolished to the ground), the resulting construction debris (including lead paint) requires Toxicity Characteristic Leaching Procedure (TCLP) analysis to make a waste determination and ensure proper management and disposal before it can be disposed as solid waste.

1.3.1.4.2 Hazardous and Universal Waste Generation

Hazardous and Universal Waste includes fluorescent bulbs, PCB ballast, lead paint, and mercury-containing equipment. Contact the EV HW Program Manager to set up an appropriate accumulation area. Manage waste in a satellite accumulation area (SAA), hazardous waste accumulation area (HWAA), or universal waste accumulation area (UWAA) as directed by the EV HW Program Manager through the Contracting Officer. Keep containers

securely closed unless adding or removing material and waste. Ensure custodians managing the accumulation area(s) have appropriate training that has been taken within the year prior to the area being established. Training is an annual requirement that can be taken on the <https://environmentaltraining.ecatts.com/> site. Keep copies of training records and certificates on site.

Hazardous Waste Accumulation Areas (less than 90-day sites) require RIDEM and/or USEPA notification. Notify the HW Media Manager (HW MM) 14 days prior to the start of waste accumulation. The EV HW Program Manager is authorized to notify RIDEM and/or EPA when Hazardous Waste Accumulation Areas are established. A copy of the Activity Hazardous Material Reutilization, Hazardous Waste Minimization and Disposal Guide will be provided by the Contracting Officer. For waste disposal, phone the Installation Hazardous Waste Manager to arrange pick up in your area. Fax a completed DD 1348-1A to the Service Desk for all waste turn-ins. Notify the Service Desk if any containers are leaking or are in poor condition. A representative from NAVSTA Newport Environmental Office is the authorized entity approved to sign manifests for off-site waste disposal.

1.3.1.4.3 Waste Management - Disposal by the Contractor

Manage and dispose of all Hazardous Waste generated or discovered during the project. Dispose of all waste in accordance with all federal and state environmental regulations. Sign and submit all paperwork (lab analyses, profiles, manifests) and records to the Navy. Allow inspection by the Installation Environmental Office and their contractors for compliance with federal, state and Navy requirements.

1.3.1.4.3.1 Contractor Site Custodian

- a. Designate a Site Custodian and an Alternate for waste management. Provide 24-hour phone numbers where Site Custodian and alternate can be contacted in the event of an emergency.
- b. Personnel must be trained in hazardous waste management procedures to comply with the requirements of 40 CFR 262.34 and 40 CFR 265.16.

1.3.1.4.3.2 Waste Accumulation

- a. Establish a SAA, UWAA or a temporary 90-Day HWAA for waste accumulation. Obtain the HW Media Manager approval. Do not use accumulation areas as lay-down areas.
- b. NAVSTA Newport HW MM will notify RIDEM. Notify the HW MM 14 days prior to the start of waste accumulation. All agency notifications will originate from the NAVSTA Newport Environmental Office.
- c. The Site Custodian and Alternate must attend the HW MM training session for the management of the SAA, UWAA or HWAA.

1.3.1.4.3.3 Waste Disposal

- a. The Navy will be considered the "generator" for all waste that are generated on Navy property, regardless of whether the waste was generated as result of Contractor activity.
- b. Pack, mark, label and transport all waste in accordance with Department of Transportation 49 CFR Regulations.

- c. Obtain the EPA Hazardous Waste Identification Number (EPA ID#) for the installation or off-site Contractor location, from the NAVSTA Newport HW MM. Use the generator's EPA ID# on the Hazardous Waste Manifest.
 - (1) Provide the name and EPA ID Number for the Hazardous Waste Transporter and the disposal facility to the HW MM.
 - (2) Submit all waste profiles and documentation supporting the waste disposal to the HW MM for review.
- d. Obtain the Hazardous Waste Manifest signature from designated representative of the NAVSTA Newport Environmental Office. Obtain signature on the day the waste is scheduled to be picked up.
- e. The Contractor is to ensure that the Certificates of Disposal and Manifests are mailed to NAVSTA Newport Environmental Office, in accordance with all Federal and State regulations.

1.3.1.4.4 Painting and Paint Removal

Air-drying cans for disposal are allowed only if liquid residue meets the definition of RCRA empty; keep all paint or solvent containers closed and secured when not adding or removing material or waste. Waste paint chips and debris must be collected and sampled to determine the proper disposal method. Contact the NAVSTA Newport Environmental Office HW Program Manager for sampling requirements. If waste paint is determined to be hazardous, waste must be managed as hazardous, and an appropriate accumulation area must be established. Contact the NAVSTA Newport Environmental Office HW Program Manager for site setup.

1.3.1.4.5 Dumpsters

Label trash containers to appropriately describe the contents.

1.3.1.5 Air Requirements:

1.3.1.5.1 Concrete Crushing

Secure an air permit for the crusher from the regulatory agency where the equipment is home-based. Provide a copy of the permit to the EV Office (Air Program Manager) through the Contracting Officer at least 30 days prior to bringing crusher onsite.

1.3.1.6 Spill Response and Reporting

Report spills at NAVSTA Newport to the appropriate installation Emergency Call Center (ECC) immediately upon discovery.

After notifying the installation ECC, notify the Navy point of contact. Refer to the Installation Hazardous Material Reutilization, Hazardous Waste Minimization and Disposal Guide Appendix 3 for spill contact procedures. Refer to Table 1 of that guide- Spill Reporting Contact Number for the appropriate point of contact.

1.3.1.7 Naval Station Newport

1.3.1.7.1 Management of Excavated Soils

NAVSTA Newport was established in 1869 with the construction of a torpedo station. The Navy War College was added in 1884 and the site was used for sailor training and housing and fueling facilities during World War II (WWII). Post WWII the property footprint and training activities were reduced while research and development efforts were increased. The soils on the property were found to contain arsenic that exceeds regulatory levels during a property-wide site investigation that included the collection and analysis of more than 1000 soil samples. These soils must be removed and disposed of, or covered with RIDEM-approved engineered controls, consisting of building foundations, asphalt pavement, and landscaping and environmental land use controls (ELUR) to prevent direct exposure to regulated soils.

The direct exposure pathway is the primary concern at the site. Individuals engaged in activities at the site may be exposed through incidental ingestion, dermal contact, or inhalation of entrained soil particles if proper precautions are not taken. Therefore, follow procedures described in Section 3.1.1.1.1 to minimize the potential of exposure.

1.3.1.7.2 Unauthorized Access

During site work, take the appropriate precautions to restrict unauthorized access to the property.

1.3.1.7.3 Worker Health and Safety

Persons involved in the excavation and handling of the material on the site are required to have Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) 40-hour and 8-hour refresher training. To ensure the health and safety of on-site workers, persons involved in the excavation and handling of the material on site are required to wear a minimum of Level D personal protection equipment, including gloves, work boots and eye protection. Workers are also required to wash their hands with soap and water prior to eating, drinking, smoking, or leaving the site.

1.3.1.7.4 Disturbance of Engineering Controls

In accordance with the RIDEM's requirements, no soil at the property is to be disturbed after an engineering control has been implemented in any manner without prior written permission of the RIDEM's Office of Waste Management, except for minor inspections, maintenance, and landscaping activities that do not disturb the contaminated soil that is left in place.

1.3.1.7.5 Annual Notification

As part of the notification process, the Navy will publish a notice, annually in the Newport Daily News that indicates that soil contains arsenic above RIDEM's Method 1 Direct Exposure Criteria, that soil work is planned on the property, and that individuals will be notified if work is to be done adjacent to privately-owned property.

1.3.1.7.6 Annual Reporting

The Navy will prepare an annual report to be submitted to the RIDEM that summarizes construction work done on the property where soil was removed and inspections of sites on the property where soils with arsenic have been left in place and land use restrictions have been applied.

For soil that is removed, the report will identify the location, quantity, and ultimate destination. For sites with land use restrictions the inspections will include the location of the site and certification that the engineering controls remain in place.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 MID-ATLANTIC

3.1.1 Rhode Island

3.1.1.1 Naval Station Newport

3.1.1.1.1 Management of Excavated Soils

Procedures in this section are to be followed for construction, demolition, or maintenance activities at NAVSTA Newport that require the management of disturbed or excavated soil. These procedures are not to be used to manage soils on Navy Installation Restoration (IR) sites, soils with known contamination (e.g., PCBs, asbestos, or mercury), soils regulated by the State of RI with contamination other than arsenic, and on property leased to private entities (e.g., privatized Housing). For contaminated soils, refer to Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL.

These procedures, and affiliated ELUR (when applicable), restricts the property to industrial or commercial usage, and pertains to the entire property.

3.1.1.1.2 Dust Suppression

During all site/earth work, employ dust suppression (i.e., watering) techniques at all times. If an unexpected observation or situation arises during site work, such activities will immediately stop (such as olfactory or visual evidence of waste material or contamination, PCB contamination or asbestos debris disposal). Immediately notify the Contracting Officer. Do not disturb this material until authorized by the Contracting Officer.

3.1.1.1.3 Excess Soil

If excess soil is generated or excavated from the property, the soil is to remain on-site for analytical testing to be performed by an Environmental Professional, to determine the appropriate disposal and/or management options. Place soil on and covered with polyethylene/plastic sheeting during the entire duration of its staging and secured with appropriate controls to limit the loss of the cover and protect against storm-water and/or wind erosion (i.e., hay bales, silt fencing, rocks, etc.). Soil

identified as contaminated is to be handled pursuant with Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL.

3.1.1.1.4 Staging of Excavated Soil

Excavated soils are to be staged and temporarily stored in a designated area of the property. Within reason, the storage location will be selected to limit the unauthorized access to the materials (i.e., away from public roadways/walkways). No soil will be stockpiled on-site for greater than 60 days without prior RIDEM approval.

3.1.1.1.5 Reuse of Excavated Soil

Soils excavated from the site may not be re-used as fill on residential property or at non-Department of the Navy commercial or industrial property. Soils designated for on-site reuse must meet specifications for intended use pursuant to Section 31 23 00.00 20 EXCAVATION AND FILL and be recapped pursuant to 3.1.1.1.9.

Excavated soil that will not be reused on-site must be properly managed and disposed of off-site at a licensed facility. Pursuant to Section 01 57 19 (3.7.2.2) a Subtitle D RCRA permitted landfill is the minimum acceptable off-site solid waste disposal option.

3.1.1.1.6 Off-Site Disposal of Excavated Soil

Site soils, which are to be disposed of off-site, must be done so at a licensed facility in accordance with all local, state, and federal laws. Copies of the material shipping records associated with the disposal of the material shall be maintained by the site owner and included in the annual inspection report for the site.

3.1.1.1.7 Soil Management Practices

At all times, employ best soil management practices. Segregated regulated soils into separate piles (or cells or containers) as appropriate based upon the results of analytical testing, when on-site reuse is planned or disposal at a RIDEM-approved licensed facility.

3.1.1.1.8 Decontamination

All non-disposable equipment used during the soil disturbance activities will be properly decontaminated as appropriate prior to removal from the site. Properly containerize and dispose of all disposable equipment used during the soil disturbance activities following completion of the work. Properly decontaminate vehicles utilized during the work, as appropriate, prior to leaving the site.

3.1.1.1.9 Recapping of Surplus Soil

At the completion of site work, all exposed soils that remain on the site (i.e., have not been removed to licensed disposal facility) are required to be recapped with RIDEM-approved engineered controls - 2 feet of clean fill or equivalent; building foundations; 4 inches of pavement/concrete underlain with 6 inches of clean fill; and/or 1 foot of clean fill underlain with a geotextile liner - consistent or better than the site surface conditions prior to the work that took place. These measures must also be consistent with the RIDEM-approved ELUR recorded on the property. Any clean fill material brought on site is required to meet the RIDEM's

Method 1 Residential Direct Exposure Criteria or be designated by an Environmental Professional as Non-Jurisdictional under the Remediation Regulations DEM-DSR-01-93. The Annual Inspection Report for the site, or Closure Report if applicable, should include either analytical sampling results from the fill demonstrating compliance or alternatively include written certification by an Environmental Professional that the fill is not jurisdictional.

-- End of Section --

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SECTION 01 57 24

TURBIDITY CONTROL AND MONITORING

PART 1 GENERAL

1.1 SUMMARY OF WORK

The work under this section consists of providing turbidity curtains and monitoring turbidity levels in the Narragansett Bay adjacent to the work area during the installation or extraction of piling and drilled shafts for the NOAA Pier project at Naval Station (NAVSTA) Newport, Rhode Island. The Contractor shall furnish all materials, labor, equipment, and incidental items necessary for turbidity control and monitoring as indicated on the drawings and specified herein.

1.2 REFERENCES

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 7027-1 (2016) Determination of Turbidity - Part
1: Quantitative Methods

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 180.1 (1993) Method 180.1: Determination of
Turbidity by Nephelometry

1.3 DEFINITION

Turbidity Monitor - The Contractor's organization responsible for implementing the Turbidity Control Plan described in this Section.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification; submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Turbidity Control Plan; G

SD-03 Product Data

Buoy-Mounted Turbidity Monitors; G

Hand-Held Turbidity Monitor; G

1.5 PERMIT

The Contractor shall comply with conditions and requirements of the project permits. The permits are included in Appendix C - Environmental Concurrence and Permit Documents of these specifications.

1.6 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain during the life of the contract, environmental protective measures. Comply with Federal, State, and local regulations pertaining to water, air, and noise pollution. Provide turbidity curtains and monitoring as indicated.

1.7 TURBIDITY CONTROL PLAN

The Contractor shall submit a written Turbidity Control Plan. The plan shall include, but not be limited to, the following:

- a. Equipment and material specifications.
- b. Location of deployment.
- c. Operational methods for deployment, data extraction, maintenance, calibration, and removal.
- d. Prior to the installation of the turbidity curtain and its accessories, and in advance of pile driving/extraction and drilled shaft construction activities, the Contractor shall submit the manufacturer's drawings and the technical specifications to the Contracting Officer for approval.

PART 2 PRODUCTS

2.1 BUOY-MOUNTED TURBIDITY MONITORS

The Buoy-Mounted Turbidity Monitors shall include, but not be limited to the following:

- a. Buoy-mounted turbidity monitors will each consist of an industry standard marine buoy with YSI 6136 Turbidity Sensors on three water quality sondes (YSI 6000MS V2) (one sensor on each of three sondes) for water depths in excess of 20 feet.
- b. The buoy itself will be of rugged construction; 30-inch diameter hull, 300-pound buoyancy with platforms constructed of an inner core of cross-linked polyethylene foam with a tough polymer skin coating.
- c. The topside instrument mast will house the data logger, solar panel, antenna, and navigational beacon.
- d. The equipment will be articulated with top and bottom mounted stainless steel eye-nuts to accommodate moorings and lifting rigs for quick and easy deployment.
- e. Equipment will include radio frequency telemetry base station to allow for remote, real-time data collection from the start of turbidity monitoring during the pre-excavation period to the conclusion of sediment removal. Baseline conditions will be established by the Contractor prior to the start of piling and drilled shaft construction operations and operational turbidity monitoring. The sensor will measure turbidity (including a turbidity wiper tool for long term monitoring) using the ISO 7027-1 Method (equivalent to USEPA Method EPA 180.1).
- f. 'Alarm Notification' to quickly notify Contracting Officer and

Contractor at the same time if turbidity levels are approaching a specified range.

2.2 HAND-HELD TURBIDITY MONITOR

The Hand-Held Turbidity Monitor shall include, but not be limited to the following:

- a. Hand held turbidity monitoring equipment will consist of a hand-held display (YSI 650 MDS Multiparameter Display System) with a YSI 6136 Turbidity Sensor mounted on a water quality sonde (YSI 6000MS V2) or equivalent as permitted in writing by the Contracting Officer.
- b. Identical sondes will be used for anchored and hand-held monitors for comparison of results.

2.3 TURBIDITY CURTAIN SYSTEM

The Turbidity Curtain System shall be as indicated, and meet these additional requirements:

a. Turbidity Curtain

- (1) CT SE SC Type IV heavyweight or USACE Type III heavy duty curtain fabric should be provided unless otherwise requested and approved by the Contracting Officer in writing. Turbidity curtain shall consist of impervious vinyl coated woven geotextile and pervious woven geotextile filter free of tears and gaps and capable of maintaining turbidity levels outside the confines of the curtain as determined by sonde readings to less than indicated notification levels.
- (2) Impervious geotextile for portion containing floatation devices, high visibility safety fluorescent orange, The curtain shall have a high resistance to weathering, hydrocarbons, salt water, and temperature extremes.
- (3) Seams, if required, shall be either vulcanized welded or sewn and shall be of the same or greater strength of the material itself.
- (4) The turbidity curtain, as prepared for installation, shall be of sufficient depth to account for water depth and wave action. Furling lines are to be spaced as necessary so that the Contractor will be able to adjust the draft of the turbidity curtains to match the various water depths.

b. Floatation Units

- (1) Floatation devices shall be suitable for marine applications and fabricated into the top of the turbidity curtain.
- (2) Flotation units shall be flexible, buoyant units contained in a flotation sleeve or collar attached to the turbidity curtain.

PART 3 EXECUTION

3.1 TURBIDITY CURTAIN SYSTEM

The turbidity curtain system shall be installed around areas of pile driving/extraction and drilled shaft construction as indicated and must meet the following requirements:

- a. Turbidity curtains shall provide sedimentation protection of the Thames River from resuspended sediment resulting from pile driving/extraction and drilled shaft construction activities.
- b. The turbidity curtain shall remain in place at all times during piling and drilled shaft construction activities. However, the turbidity curtain may be temporarily opened to facilitate relocation of equipment or removed upon completion of activities provided the turbidity levels within the confines of the curtain removal area are less than notification levels.

3.2 MONITORING

Turbidity monitoring shall be as indicated and as follows:

a. Baseline Monitoring

- (1) Baseline monitoring will be conducted in advance of piling and drilled shaft construction operations. Monitoring is meant to establish baseline turbidity conditions within the work areas to provide a basis of comparison for subsequent construction quality control monitoring.
- (2) The Turbidity Monitor will provide and install one buoy-mounted (anchored) meter at the locations indicated for seven days prior to the commencement of piling and drilled shaft construction activities to determine the turbidity baseline notification level (background plus 20 percent) in the water column for each sonde. Actual locations are to be determined in the field based on survey measurements
- (3) The bottom of the upper sonde shall be placed approximately 5 feet below the water surface while the bottom of the lower sonde will be placed no more than 3 feet above the river bottom at mean low water. A third sonde will be placed at approximately mid-point between the upper and lower sonde.
- (4) The sondes will be attached to the buoy and data logging equipment by the vendor supplied cords. The cords will be adjusted at the time of deployment so that the sondes are located at the predetermined depths. Supplied cords will provide sufficient allowance for monitoring at the required depths and the Turbidity Monitor will make adjustments to the cord length as required to account for tidal changes at the specific location of monitor deployment.
- (5) The buoy-mounted turbidity monitor will be anchored in place and will not be moved for the duration of baseline monitoring activities.
- (6) After calibration in accordance with manufacturers direction or as

otherwise modified herein, baseline monitoring will take place from approximately 7:00 am to 5:00 pm, depending upon the hours of daylight and the Contractor's plan for operating hours during piling and drilled shaft construction activities. During this period, measurements will be collected at 10 minute intervals in real-time using NexSens' iChart software (serves as the centralized database for all incoming data) or equivalent as approved by the Contracting Officer in writing. All data from the NexSens systems will be sent in real-time to the on-site computer running NexSens iChart software. The Turbidity Monitor will download turbidity and associated data (e.g., running average) from the telemetry units at the frequency specified in the Turbidity Control Plan and upload the data to a continuous Microsoft Excel spreadsheet and time-series graph and provide to the Contracting Officer.

- (7) The Turbidity Monitor shall remove the monitor from the water in advance of significant weather events as specified in the Turbidity Control Plan and reinstall the monitor in the same location following the event. After each removal event or more frequently as specified by the manufacturer, the equipment shall be recalibrated. Maintenance of the units while deployed should be consistent with manufacturer's recommendations unless readings are obscured in which case the unit should be inspected and maintained for proper operation.
- (8) The turbidity notification level for construction quality control monitoring will be determined by taking an average of the 7-day monitoring results and adding 20 percent.

b. Construction Quality Control Monitoring - Using Anchored Equipment

- (1) Construction quality control monitoring will be conducted by the Turbidity Monitor during piling and drilled shaft construction operations. Monitoring is meant to verify that turbidity readings observed during these operations are below notification levels established based on baseline monitoring
- (2) The Turbidity Monitor will provide and install three anchored buoy mounted turbidity monitors outside of the turbidity curtain surrounding the active work area at the locations indicated for the duration of the project. Monitors will assess real time turbidity for comparison with the previously established turbidity notification level in the water column for each sonde. Actual locations are to be determined by the Contracting Officer based on the results of baseline monitoring and the Turbidity Control Plan. Turbidity monitoring stations will be laid out focusing on the areas of active piling and drilled shaft construction activities.
- (3) For each buoy-mounted turbidity monitor the bottom of the upper sonde shall be placed approximately 5 feet below the water surface while the bottom of the lower sonde will be placed no more than 3 feet above the river bottom at mean low water. A third sonde will be placed at approximately mid-point between the upper and lower sonde. Turbidity Monitor will make adjustments to the cord length as required to account for tidal changes.
- (4) The sondes will be attached to the buoy and data logging equipment by the vendor supplied cords. The cords will be adjusted at the

time of deployment so that the sondes are located at the required depths. Supplied cords will provide sufficient allowance for monitoring at the required depths and Turbidity Monitor will make adjustments to the cord length as required to account for tidal changes.

- (5) Buoy-mounted turbidity monitors are only required to be operational from commencement of piling and drilled shaft construction activities until one hour after the activities cease. During this period, measurements will be collected at 10 minute intervals in real-time using NexSens iChart software (serves as the centralized database for all incoming data) or other as approved by Contracting Officer. All data from the NexSens systems will be sent in real-time to the on-site computer running NexSens iChart software by the Turbidity Monitor. The Turbidity Monitor will download turbidity and associated data (e.g., running average) from the telemetry units 4 times per day and upload the data to a continuous Microsoft Excel spreadsheet and time series graph and provide to the Contracting Officer.
- (6) Buoy-mounted turbidity monitors will be anchored in place and will not be moved during piling and drilled shaft construction operations unless deemed necessary by the Contracting Officer to perform work activities or in the event of severe weather conditions
- (7) The Turbidity Monitor shall remove the monitor from the water in advance of significant weather events and reinstall the monitor in the same location following the event. After each removal event or more frequently as specified by the manufacturer, the equipment shall be recalibrated. Maintenance of the units while deployed should be consistent with manufacturer's recommendations unless readings are obscured in which case the unit should be inspected and maintained for proper operation
- (8) In order to mitigate potential downtime and/or validity of data, the Turbidity Monitor will have on-hand two spare sondes for spot-checking, or to quickly replace a damaged/faulty sonde.
- (9) The Turbidity Monitor will remove buoy-mounted turbidity monitors following completion of piling and drilled shaft construction activities.
- (10) The notification level for each sonde will initially be set at the indicated threshold value above the background levels. If the turbidity outside the turbidity curtains exceeds the notification level, the Contracting Officer will be notified. If the turbidity notification levels are consistently exceeded and cannot be attributed to migration from outside the work area (e.g., seasonal variations, recent rains, etc.), the contractor will implement best management practices (e.g., curtain placement, temporarily cease piling and drilled shaft construction operations, revised construction procedures, etc.), subject to the approval of the Contracting Officer, to control turbidity. Contracting Officer approval is required for changes to the notification level.
- (11) The Contractor shall bear all costs, associated delays and work stoppages due to exceedance of notification levels attributable to piling or drilled shaft construction operations, or turbidity

curtain failures.

- (12) The Turbidity Monitor will calibrate each water quality sonde as specified in the Turbidity Control Plan. Turbidity calibration is a minimum of a 2-point calibration and must meet manufacturer specified methods for calibration

c. Construction Quality Control Monitoring - Using Handheld Equipment

- (1) The Turbidity Monitor will supply one hand-held turbidity meter to be used within the confines of the curtain prior to the turbidity curtain being opened to allow a marine vessel to enter or exit the work zone. The area just inside the turbidity curtain will be monitored with a hand-held turbidity meter only when the curtain needs to be breached (i.e., vessels need to enter or exit the work zone) to monitor for potential suspension of contaminated sediment.
- (2) When the opening of the turbidity curtain is imminent, the Turbidity Monitor will take several measurements in the river along the inside of the turbidity curtain of each work zone (section to be opened).
- (3) Measurements will be taken by the Turbidity Monitor at four locations, one on each side of the barge at three depth intervals should depths exceed 20 feet. This will be done by lowering the sonde so that the bottom of the sonde is approximately 5 feet below the water surface and then to a depth no more than 3 feet above the river at mean low water conditions and at a mid-point depth corresponding to the depths at which the anchored meters are collecting data. Supplied cords will provide sufficient allowance for monitoring at the required depths.
- (4) If the turbidity measurement for each depth at all four locations in the monitoring cycle are found to be less than the turbidity notification level, the Contractor may open the turbidity curtain to allow the vessel to enter/exit the work zone. If the turbidity measurement is found to be above the notification level at any one or more locations, the depths at this location will be designated for re-monitoring at the end of the monitoring cycle and will be checked again. Monitoring data will be logged and continue at a minimum frequency of every 10 minutes until the turbidity reduces and a turbidity measurement allowing the curtain breach is reached.
- (5) The Turbidity Monitor will download turbidity data from the hand-held equipment at the end of each workday and import it to a continuous Microsoft Excel spreadsheet for project files.
- (6) The Turbidity Monitor will calibrate each hand-held water quality sonde as specified in the Turbidity Control Plan. Turbidity calibration is typically a 2-point calibration and must meet manufacturer specified methods for calibration.

3.3 TURBIDITY CURTAIN

a. Maintenance of Turbidity Curtain

- (1) Throughout the project construction period, the Contractor shall maintain the turbidity curtain so that no re-suspended sediment enters the waterway beyond the confines of the turbidity curtain.

- (2) All sections of the turbidity curtain damaged prior to installation, during installation, or during the project shall be repaired or replaced to the satisfaction of the Contracting Officer at no additional cost.
- (3) The Contractor shall inspect at a minimum daily and immediately after dislodgement, movement, or contact with equipment occurs for holes, breaches in seams, damage to anchor connections, or other damage that may compromise the function of the turbidity curtain.
- (4) The Contractor shall repair immediately any damage in accordance with manufacturer's instructions or replace the section of curtain entirely with standby curtains at no additional cost.
- (5) Any folds in the turbidity curtain which form next to the floatation collar shall be regularly monitored and freed of collected sediment.
- (6) The Contractor will provide an appropriate vessel to facilitate completion of routine curtain inspections by the Contracting Officer

b. Removal of Turbidity Curtain

- (1) The turbidity curtain shall remain in place until the piling and drilled shaft construction activities are complete and the turbidity measurements within the curtain are consistent with background levels.
- (2) When directed by the Contracting Officer, the turbidity curtain shall be furled in place, then released from its anchors and towed out of the water.
- (3) The turbidity curtain and all materials incidental to the construction of the turbidity curtain shall be removed in such a manner as to minimize turbidity to adjacent waters.
- (4) The turbidity curtain and related components shall become the property of the Contractor and shall be removed from the site and disposed accordingly following completion of work.

3.4 TURBIDITY MONITORING PLAN

Turbidity monitoring must be conducted by the Contractor during marine turbidity producing or noise producing work for the NOAA project between the time period of 1 February to 31 May of each year. The work area will be surrounded by a siltation curtain and monitored for turbidity.

Turbidity monitors to be used during marine work activities will be placed within 15 feet of the turbidity curtain and as close as possible to the active work. The Contractor will determine the location where each turbidity curtain will be opened to allow for curtain installation prior to work and removal after the work. Criteria for opening and closing the turbidity curtain will be linked to the turbidity levels inside the curtain meeting acceptable levels and shall not be dictated by a specific time frame. Turbidity curtain layout and monitoring locations will be verified based on activities in the site vicinity when each work activity is to be performed.

The following table summarizes the monitoring system scenarios, which will allow the Contractor to respond if re-suspended sediment levels exceed pre-established parameters by slowing down or altering the work. The buoy-mounted monitors and one handheld turbidimeter will have identical sondes, so that turbidity data collected is comparable. There will be one turbidity monitor location on the side of each work area exposed to open ocean. As work proceeds, a turbidity monitor will be moved where active work is occurring.

Table 1. Summary of Turbidity Monitoring Scenarios

Scenario	Turbidity Monitoring Plan
Actively working	<ul style="list-style-type: none">o One buoy mounted monitoring system, with three sondes each to monitor three depthso One hand held meter (will have sufficient cord to measure the same three depths as buoy mounted sondes) (will be used to determine if the turbidity curtain can be opened)
No active work	<ul style="list-style-type: none">o One buoy mounted monitoring system, with three sondes each to monitor three depths

To verify the control of re-suspended sediment, turbidity will be monitored outside the work area using the buoy-mounted sondes to collect real time background turbidity data. This monitoring will provide an opportunity to adjust the operations to reduce turbidity. The Contractor will have access to real-time turbidity data from each monitoring station and can adjust the operational procedure (cycle time, cleaning, etc.) to ensure that the turbidity readings do not exceed the established standards.

If the action level of 10 NTUs is exceeded at either of the turbidity monitors positioned outside of the turbidity curtains during in-water demolition and/or pile or drilled shaft installation activities, the Contractor will take immediate action to reduce the amount of sediment being re-suspended (i.e., evaluate cause, slow work activities, etc.). If the turbidity action level is continuously exceeded and cannot be attributed to migration from within the work area, the turbidity action level will be reviewed with the Government to determine a course of action (i.e., increasing the action level to background plus 20% NTUs).

3.5 PROCEDURE FOR TURBIDITY MONITORING VIA ANCHORED EQUIPMENT

This turbidity monitoring equipment will consist of one industry standard marine buoy with turbidity sensors on three water quality sondes (one sensor on each of three sondes), which will be placed at three depths. All water quality equipment shall be integrated into a single system, complete with a single, centralized database linked to a web interface.

- 1) Specifications for water quality sensors:

- a. Fouling-resistant, wiped sensor
- b. Seamlessly integrate, using no external interface hardware, with all sondes
- c. In situ measurement of turbidity in sea water
- d. Mechanical self-wiping capability for long-term deployment
- e. Sensor performance verified through the US EPA's Environmental Technology Verification Program
- f. (ETV).

2) Specifications for water quality sondes:

- a. Operational environment: Medium: fresh, sea, or polluted water
- b. Temperature: -5 to +50 C
- c. Depth: 0 to 200 feet (61 meters)
- d. Materials: PVC, Stainless Steel
- e. Internal logging memory size: Minimum 384 kilobytes (150,000 individual parameter readings)
- f. Battery Life: Minimum 180 days at 20 C with a 30 minute sample interval.

3) Specifications for Hand-Held Equipment:

- a. GPS
- b. Multiparameter Graphic display
- c. Logging Capabilities: Single point or Continuous
- d. Measurement Method: Digital
- e. Memory: Minimum 100,000 data sets, 400 GLP files
- f. Multiparameter: Yes
- g. Operating Temperature: 0 to 50°C (32 to 122°F)
- h. User Calibratable: Yes
- i. Waterproof: floats

Turbidity monitoring will be conducted near the surface, near the bottom (1 to 2 feet above the bay floor during low tide conditions), and midway between upper and lower depths. In addition, water depth measurements will be collected as the monitors are being deployed to ensure the sondes are placed at the appropriate depths.

The meters will be anchored in place around the work area and, as work proceeds, moved where active work is occurring; the depths of the monitors will remain fixed. The sondes will be attached to the buoy and data logging equipment by the vendor supplied cords. Cord adjustments solely for tidal changes will not be made. These will be deployed for the duration of the project but will be removed from the water in the event of significant weather events. They will only be operational during work hours.

The rugged buoy (30-inch diameter hull, 300-pound buoyancy) platforms (or equivalent) should be constructed of an inner core of cross-linked polyethylene foam with a tough polymer skin coating. The topside instrument mast should be equipped with a data logger, solar panel, antenna, and navigational beacon. Top and bottom mounted stainless steel eye-nuts accommodate moorings and lifting rigs for quick and easy deployment. In addition, a radio frequency telemetry base station unit should be installed on the buoy to allow for remote, real-time data collection from the start of turbidity monitoring during the pre-work period to the conclusion of work activities. The sensor should measure turbidity (including a turbidity wiper tool for long-term monitoring) using the ISO 7027 Method (equivalent to USEPA Method 180.1). Throughout

the project, the field team will note any change in weather, tide, vessel movement, and other events that may affect turbidity readings. The turbidity monitoring program should include the capability to manually exclude anomalous readings.

For the purposes of turbidity measuring and data recording, the accuracy of the unit should be + 2% or 0.3 NTU, the range for the unit should be 0 to 1,000 NTU, the depth rating should be 200 feet, and the response time should be instantaneous (approximately five seconds for the initial reading). During work operations, the readings will be available in real-time to allow immediate action to be taken should excessive turbidity be detected. The turbidity data will be included in the daily Contractor Production Reports.

Subsequent to initial calibration and instrument deployment, maintenance activities will be performed if a buoy and/or associated equipment is damaged or real-time data indicates probe damage or measurement drift. Further calibration of the additional probes will be performed as needed and based upon download and review of the real-time data. Field deployment, calibration and various equipment maintenance and operation will be recorded in field and summarized in daily reports. The buoy-mounted sondes will be calibrated on a monthly basis or per manufacturer's requirements.

The buoy-mounted equipment should collect monitoring results (at 10-minute intervals) in real-time using software that serves as the centralized database for all incoming data and can be exported to database spreadsheet format. In addition, the system should have an alarm to quickly notify project members with no delay if turbidity levels are approaching a specified range. The data generated should provide an on-line interface for viewing data in real-time to allow project members and stakeholders to evaluate the project information and data to monitor turbidity during work activities. The Contractor should download turbidity and associated data (e.g., running average) from the telemetry units 4 times per day and upload the data to a continuous spreadsheet and time-series graph. The software should also be used to manually filter anomalous data, which will limit the potential for turbidity spikes.

Each water quality sonde will be calibrated by the vendor and shipped with a vendor calibration report showing the pre-calibration readings of each sensor. Turbidity calibration is typically a 2-point calibration at 0 NTU and 123 NTU. The 0 NTU value can be obtained using deionized water. The 123 NTU is obtained using the 1-gallon bottle of 6073G calibration standard. The Contractor will use this standard throughout the project to maintain calibration of the equipment.

3.6 PROCEDURE FOR MONITORING TURBIDITY VIA HAND-HELD EQUIPMENT

This turbidity monitoring equipment must consist of a hand-held multiparameter display with a turbidity sensor mounted on a water quality sonde. Because identical sondes are being used (anchored versus hand-held), the results will be comparable. The sonde associated with the hand-held equipment should be calibrated on a monthly basis or per manufacturer's requirements.

When the opening of the turbidity curtain is imminent, The Contractor must take several measurements in the water along the inside the turbidity curtain. Measurements must be taken at three depth intervals. This will be done by lowering the sonde so that the bottom of the handheld

corresponds to the depths at which the anchored meters are collecting data.

The hand-held display must provide the Contractor with a real time turbidity measurement. If all turbidity measurements in the monitoring cycle are found to be less than the turbidity action level, the turbidity curtain may be opened. If a turbidity measurement is found to be above the action level, the three depths at this location will be designated for re-monitoring at the end of the monitoring cycle. Monitoring must continue at a minimum frequency of every 10 minutes until the turbidity reduces and a turbidity measurement allowing the curtain breach is collected.

The Contractor must download turbidity data from the hand-held equipment at the end of each work day it is used and import it to a spreadsheet for project files. Field deployment, calibration and various equipment maintenance and operation must be recorded in daily reports.

-- End of Section --

SECTION 01 58 00

PROJECT IDENTIFICATION

08/19, CHG 2: 11/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C1 (2003) All Timber Products - Preservative Treatment by Pressure Processes

AWPA C2 (2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Preliminary Drawing Indicating Layout And Text Content; G

SD-04 Samples

Facility Recognition Plaque; G

1.3 QUALITY CONTROL

1.3.1 Facility Recognition Plaque

Submit full size drawing of Facility Recognition Plaque for approval. Confirm the content (message), location and mounting with Contracting Officer prior to fabrication. The final names on the plaque will be determined at the end of the project duration to assure that current participants can be identified and recognized on the plaque.

1.4 PROJECT IDENTIFICATION SIGN

Prior to initiating any work on site, provide three project identification signs at these locations: two at Area Inorth and south corner and one at area D. Construct the sign in accordance with project sign detail, which can be downloaded at:

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>. Maintain sign throughout the life of the project. Upon completion of the project, remove the sign from the site. The Government will temporarily supply a copy of the rendering to use in the production of the final signboard artwork.

1.4.1 Project Identification Signboard

Provide a project identification signboard in accordance with attached Plates 2, 3, 4, and 5. Provide a preliminary drawing indicating layout and text content. Erect a signboard at a conspicuous location on the job site where directed by the Contracting Officer.

- a. The field of the sign consists of a 4 by 8 foot sheet of grade B-B medium density overlaid exterior plywood.
- b. Lumber is B or better Southern pine, pressure-preservative treated in accordance with AWPA C1 and AWPA C2. Nails are aluminum or galvanized steel.
- c. Give one coat of exterior alkyd primer and two coats of exterior alkyd enamel paint to the entire signboard and supports. Perform the lettering and sign work by a skilled sign painter using paint known in the trade as bulletin colors. The colors, lettering sizes, and lettering styles are as indicated. Where preservative-treated lumber is required, utilize only cured pressure-treated wood which has had the chemicals leached from the surface of the wood prior to painting.
- d. Use spray applied automotive quality high gloss acrylic white enamel paint as background for the NAVFAC logo. NAVFAC logo is an applied 2 mil film sticker/decals with either transparent or white background or paint the logo by stencil onto the sign. The weather resistant sticker/decals film is rated for a minimum of 2-year exterior vertical exposure. Mount the self-adhering sticker to the sign with pressure sensitive, permanent acrylic adhesive. Shop cut sticker/decals to rectangular shape and provide pull-off backing sheet on adhesive side of design sticker for shipping.
- e. Sign paint colors (manufacturer's numbers/types listed below for color identification only)
 - (1) Blue = To match dark blue color in the NAVFAC logo.
 - (2) White = To match Brilliant White color in the NAVFAC logo.
- f. NAVFAC logo must retain proportions and design integrity. NAVFAC logos in electronic format may be obtained from the NAVFAC web portal via the following link: https://www.navfac.navy.mil/about_us/logos_and_seals.html. Use the following to choose color values for the paint to be used:
 - (1) Dark Blue = equivalent to CMYK values 100, 72, 0, 8.
 - (2) Light Blue = equivalent to CMYK values 69, 34, 0, 0.
 - (3) Cyan = equivalent to CMYK values 100, 9, 0, 6.
 - (4) Yellow = equivalent to CMYK values 0.9, 94, 0.
- g. Final signboard artwork (rendering) may be either mounted under plexiglass as indicated in attached Plates 2 and 5, or may be electrostatically printed on 4 mil self-adhering, weather resistant, glossy vinyl film and mounted to signboard. Provide film that is capable of full color reproduction of the building rendering and cover

it with an ultra-violet protection film. Laminate the 2 mil satin gloss clear protection film to the white 4 mil vinyl image film. Utilize pressure sensitive "controltac" adhesive to attach rendering to signboard and smooth out surface with hand pressure tools in accordance with manufacturer's recommendations. Shop cut sticker to size required and provide pull-off backing sheet on adhesive side of film for shipping. Provide the rendering on film that is rated for a minimum of 2-years exterior vertical exposure.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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14" [355mm] DIAMETER
NOAA LOGO AVAIL:
<https://www.noaa.gov/office-of-communication/about-noaa-emblem-and-logo>

MITERED CORNER

4x4 [89mmx89mm]
PRESSURE TREATED POST;
COLOR: 'DARK BLUE', TYP.

12"x14" [300mm X 355mm]
NAVFAC LOGO AVAIL:
<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>

PAINTED FIELD; COLOR,
'WHITE'

PAINT WOOD TRIM 'DARK
BLUE'

3" [75mm] LETTERING
CENTERED
2" [(50mm)] LETTERING
CENTERED

1.5" [40mm] LETTERING
CENTERED

2" [50mm] LETTERING
CENTERED
PAINTED 3.5" [89mm]
STRIPE; COLOR, 'DARK
BLUE'

NOTES:
1. PAINT ALL OTHER WOOD
SURFACES WITH ONE COAT
EXT. PRIMER AND TWO
COATS GLOSS WHITE
ENAMEL.

2. ALL LETTERING SHALL
BE EVENLY SPACED.

3. LETTER STYLE, 'ARIAL',
COLOR 'DARK BLUE'.
TYPICAL FOR ALL
LETTERING.

*-ABBREVIATE STATE

**-CONFIRM USE WITH
CONTRACTING OFFICER

***-VERIFY NAME WITH
CONTRACTING OFFICER.

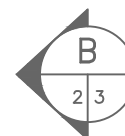
4'-0" [1220mm]



14" [355mm] DIAMETER
USN LOGO AVAIL:
<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>

CENTER LOGOS WITHIN
4'-0" X 1'-8" AVAILABLE
SPACE.

PAINTED 3.5" [89mm]
STRIPE; COLOR, 'DARK
BLUE'



PAINTED 3.5" [89mm]
STRIPE; COLOR, 'DARK
BLUE'

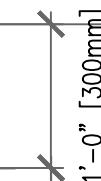
PAINTED FIELD; COLOR,
'WHITE'



2.5" [64mm] LETTERING
CENTERED

4x4 [89mmx89mm]
PRESSURE TREATED POST
BEYOND; COLOR: 'WHITE'

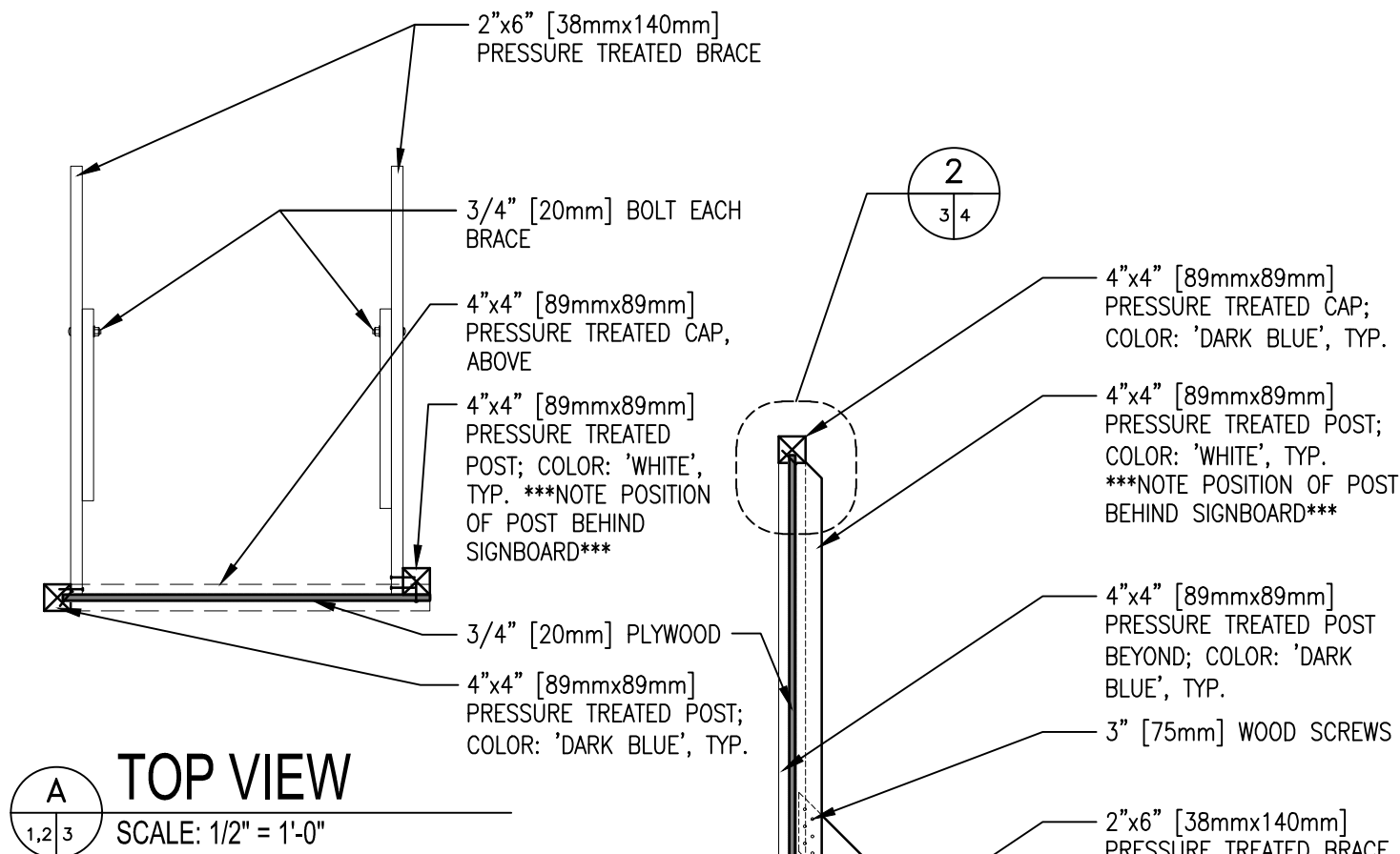
GROUND LEVEL



NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND PROJECT IDENTIFICATION SIGNBOARD

SCALE: 3/4" = 1'-0"

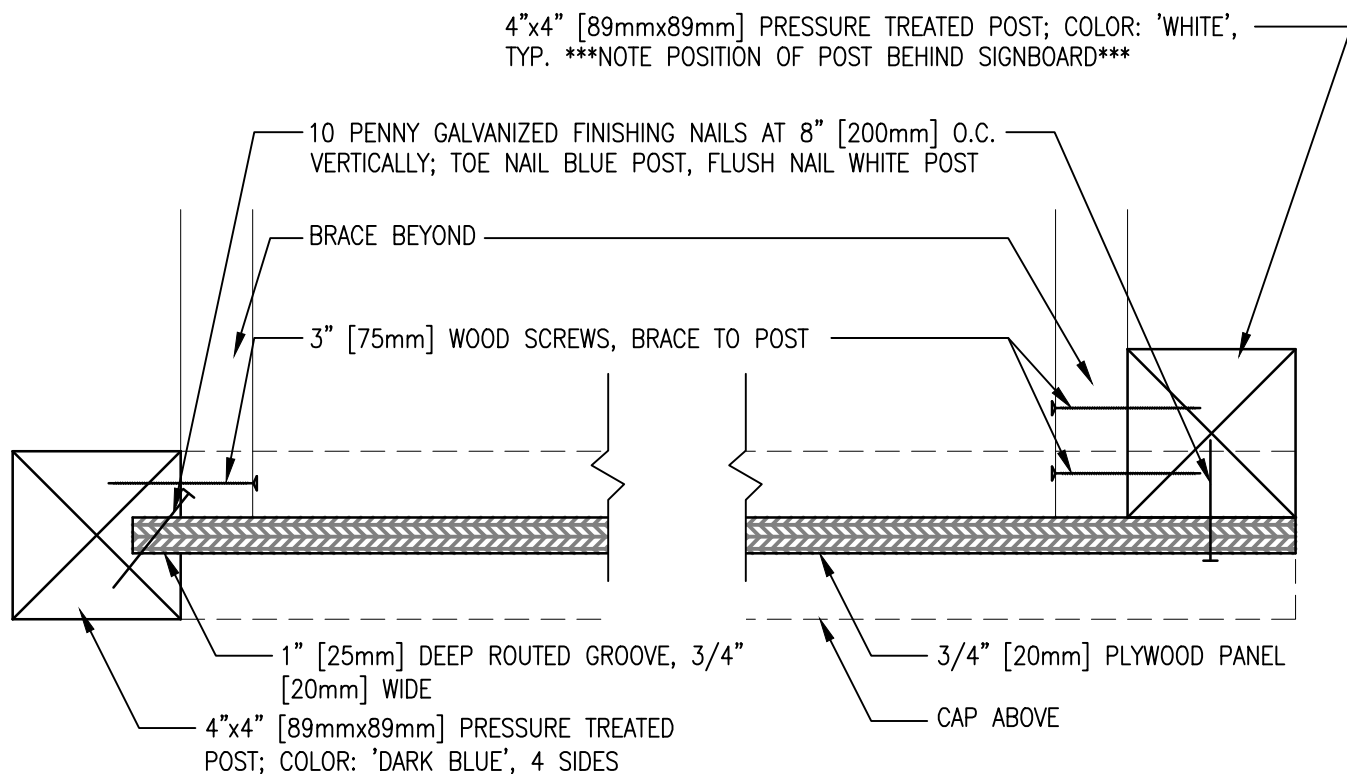
PLATE 2USN



NOTES:

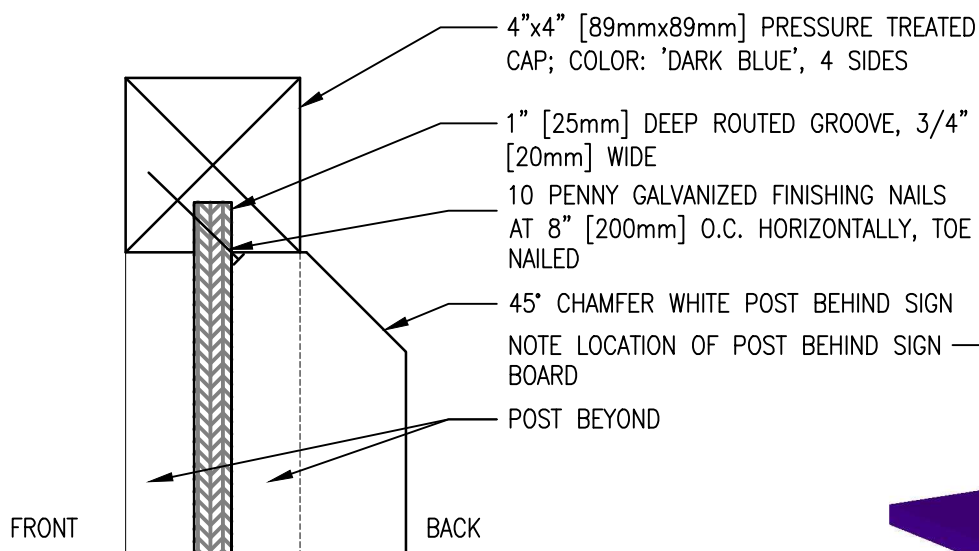
1. POSTS AND BRACES SHALL BE PRESSURE TREATED.
2. ALL FASTENERS SHALL BE ZINC COATED.
3. BRACING IS REQUIRED IN ALL SOIL CONDITIONS AND HIGH WIND ENVIRONMENTS.

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND
PROJECT IDENTIFICATION SIGNBOARD
SUPPORT DETAILS



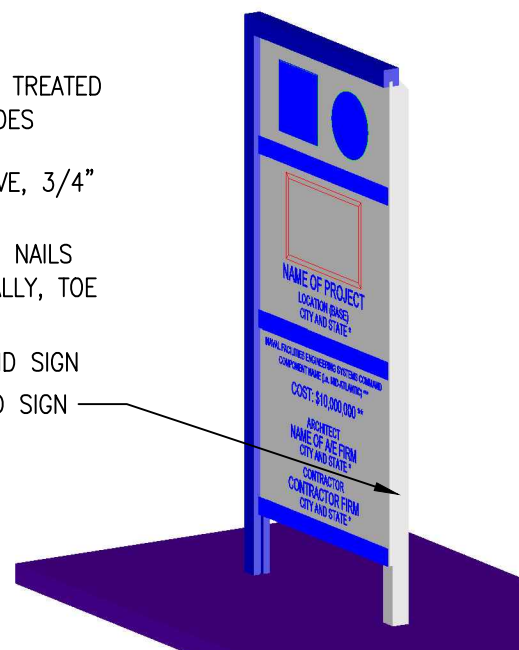
1 PLAN SECTION

SCALE: 3" = 1'-0"



2 SECTION AT TOP

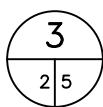
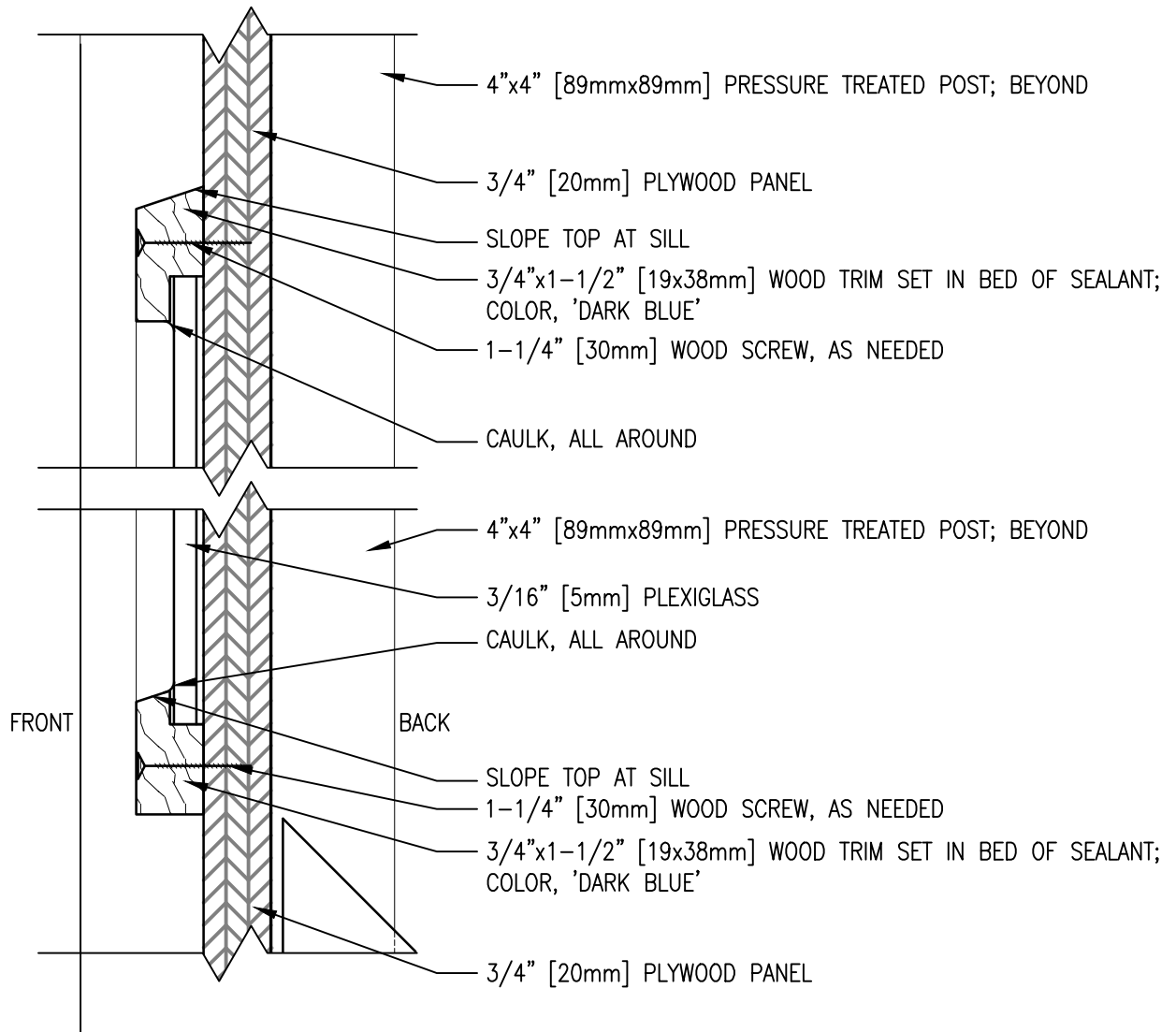
SCALE: 3" = 1'-0"



3 ISO VIEW

SCALE: NONE

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND
PROJECT IDENTIFICATION SIGNBOARD SECTIONS



SECTION AT RENDERING FRAME

SCALE: 6" = 1'-0"

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND
PROJECT IDENTIFICATION SIGNBOARD SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
02/19, CHG 1: 08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 273	Standards for Universal Waste Management
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

1.2 DEFINITIONS

1.2.1 Co-mingle

The practice of placing unrelated materials together in a single container, usually for benefits of convenience and speed.

1.2.2 Construction Waste

Waste generated by construction activities, such as scrap materials, damaged or spoiled materials, temporary and expendable construction materials, and other waste generated by the workforce during construction activities.

1.2.3 Demolition Debris/Waste

Waste generated from demolition activities, including minor incidental demolition waste materials generated as a result of Intentional dismantling of all or portions of a building, to include clearing of building contents that have been destroyed or damaged.

1.2.4 Disposal

Depositing waste in a solid waste disposal facility, usually a managed landfill, regulated in the US under the Resource Conservation and Recovery Act (RCRA).

1.2.5 Diversion

The practice of diverting waste from disposal in a landfill, by means of eliminating or minimizing waste, or reuse of materials.

1.2.6 Final Construction Waste Diversion Report

A written assertion by a material recovery facility operator identifying

constituent materials diverted from disposal, usually including summary tabulations of materials, weight in short-ton.

1.2.7 Recycling

The series of activities, including collection, separation, and processing, by which products or other materials are diverted from the solid waste stream for use in the form of raw materials in the manufacture of new products sold or distributed in commerce, or the reuse of such materials as substitutes for goods made of virgin materials, other than fuel.

1.2.8 Reuse

The use of a product or materials again for the same purpose, in its original form or with little enhancement or change.

1.2.9 Salvage

Usable, salable items derived from buildings undergoing demolition or deconstruction, parts from vehicles, machinery, other equipment, or other components.

1.2.10 Source Separation

The practice of administering and implementing a management strategy to identify and segregate unrelated waste at the first opportunity.

1.3 CONSTRUCTION WASTE (INCLUDES DEMOLITION DEBRIS/WASTE)

Divert a minimum of 75 percent by weight of the project construction waste and demolition debris/waste from the landfill. Follow applicable industry standards in the management of waste. Apply sound environmental principles in the management of waste. (1) Practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction waste and demolition debris/waste from landfills and incinerators and to facilitate the recycling or reuse of excess construction materials.

1.4 CONSTRUCTION WASTE MANAGEMENT

Implement a construction waste management program for the project. Take a pro-active, responsible role in the management of construction construction waste, recycling process, disposal of demolition debris/waste, and require all subcontractors, vendors, and suppliers to participate in the construction waste management program. Establish a process for clear tracking, and documentation of construction waste and demolition debris/waste.

1.4.1 Implementation of Construction Waste Management Program

Develop and document how the construction waste management program will be implemented in a construction waste management plan. Submit a Construction Waste Management Plan to the Contracting Officer for approval. Construction waste and demolition debris/waste materials include un-used construction materials not incorporated in the final work, as well as demolition debris/waste materials from demolition activities or deconstruction activities. In the management of waste, consider the availability of viable markets, the condition of materials, the ability to

provide material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates.

1.4.2 Oversight

The Environmental Manager, as specified in Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS, is responsible for overseeing and documenting results from executing the construction waste management plan for the project.

1.4.3 Special Programs

Implement any special programs involving rebates or similar incentives related to recycling of construction waste and demolition debris/waste materials. Retain revenue or savings from salvaged or recycling, unless otherwise directed. Ensure firms and facilities used for recycling, reuse, and disposal are permitted for the intended use to the extent required by federal, state, and local regulations.

1.4.4 Special Instructions

Provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the projects. Designation of single source separating or commingling will be clearly marked on the containers.

1.4.5 Waste Streams

Delineate waste streams and characterization, including estimated material types and quantities of waste, in the construction waste management plan. Manage all waste streams associated with the project. Typical waste streams are listed below. Include additional waste streams not listed:

- a. Land Clearing Debris
- b. Asphalt
- c. Masonry and CMU
- d. Concrete
- e. Metals (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, bronze, etc.)
- f. Wood (nails and staples allowed)
- g. Glass
- h. Paper
- i. Plastics (PET, HDPE, PVC, LDPE, PP, PS, Other)
- j. Gypsum
- k. Non-hazardous paint and paint cans
- l. Carpet

- m. Ceiling Tiles
- n. Insulation
- o. Beverage Containers

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction Waste Management Plan; G

SD-11 Closeout Submittals

Final Construction Waste Diversion Report; S

1.6 MEETINGS

Conduct Construction Waste Management meetings. After award of the Contract and prior to commencement of work, schedule and conduct a meeting with the Contracting Officer to discuss the proposed construction waste management plan and to develop a mutual understanding relative to the management of the construction waste management program and how waste diversion requirements will be met.

The requirements of this meeting may be fulfilled during the coordination and mutual Understanding meeting outlined in Section 01 45 00.00 20 QUALITY CONTROL. At a minimum, discuss and document waste management goals at following meetings:

- a. Preconstruction meeting.
- b. Regular Quality Control meetings.
- c. Work safety meeting (if applicable).

1.7 CONSTRUCTION WASTE MANAGEMENT PLAN

Submit Construction Waste Management Plan within 15 calendar days after contract award. Revise and resubmit Construction Waste Management Plan until it receives final approval from the Contracting Officer, in order for construction to begin. Execute demolition or deconstruction activities in accordance with Section 02 41 00 DEMOLITION. Manage demolition debris/waste or deconstruction materials in accordance with the approved construction waste management plan.

An approved construction waste management plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Ensure all subcontractors receive a copy of the approved Construction Waste Management Plan. The plan demonstrates how to meet the project waste diversion requirement. Also, include the following in the plan:

- a. Identify the names of individuals responsible for waste management and

waste management tracking, along with roles and responsibilities on the project.

- b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.
- c. Description of the regular meetings to be held to address waste management.
- d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of materials.
- e. Name of landfill and/or incinerator to be used.
- f. Identification of local and regional re-use programs, including non-profit organizations such as schools, local housing agencies, and organization that accept used materials such as material exchange networks and resale stores. Include the name, location, phone number for each re-use facility identified, and provide a copy of the permit or license for each facility.
- g. List of specific materials, by type and quantity, that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Identify the recycling facilities by name, address, and phone number.
- h. Identification of materials that cannot be recycled or reused with an explanation or justification, to be approved by the Contracting Officer.
- i. Description of the means by which any materials identified in item (g) above will be protected from contamination.
- j. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).
- k. Copy of training plan for subcontractors and other services to prevent contamination by co-mingling materials identified for diversion and waste materials.
- l. Identification of at least 5 construction or demolition material streams for diversion.
- m. Facilities or subcontractors offering construction waste transport on-site or off-site must ensure that proper shipping orders, bill of lading, manifests, or other shipping documents containing waste diversion information meet requirements of 40 CFR 273 Universal Waste Management, 49 CFR 173 Shippers - General Requirements for Shipments and Packagings, and 49 CFR 178 Specifications for Packaging. Individuals signing manifests or other shipping documents should meet the minimum training requirements.
- n. List each supplier who deliver construction materials, in bulk, or package products in returnable containers or returnable packaging, or have take-back programs. List each program and the applicable

material to actively monitor and track to assist in meeting waste diversion requirements on the project.

Distribute copies of the waste management plan to each subcontractor, Quality Control Manager Environmental Manager, and the Contracting Officer.

1.8 RECORDS (DOCUMENTATION)

1.8.1 General

Maintain records to document the types and quantities of waste generated and diverted through re-use, recycling and/or sale to third parties; through disposal to a landfill or incinerator facility. Provide explanations for any materials not recycled, reused or sold. Collect and retain manifests, weight tickets, sales receipts, and invoices specifically identifying diverted project waste materials or disposed materials.

1.8.2 Accumulated

Maintain a running record of materials generated and diverted from landfill disposal, including accumulated diversion rates for the project. Make records available to the Contracting Officer during construction or incidental demolition activities. Provide a copy of the diversion records to the Contracting Officer upon completion of the construction, incidental demolitions or minor deconstruction activities.

1.9 FINAL CONSTRUCTION WASTE DIVERSION REPORT

A Final Construction Waste Diversion Report is required at the end of the project. Provide Final Construction Waste Diversion Report 60 days prior to the Beneficial Occupancy Date (BOD). The final Construction Waste Diversion Report must be included in the Sustainability eNotebook in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

1.10 COLLECTION

Collect, store, protect, and handle reusable and recyclable materials at the site in a manner which prevents contamination, and provides protection from the elements to preserve their usefulness and monetary value. Provide receptacles and storage areas designated specifically for recyclable and reusable materials and label them clearly and appropriately to prevent contamination from other waste materials. Keep receptacles or storage areas neat and clean.

Train subcontractors and other service providers to either separate waste streams or use the co-mingling method as described in the construction waste management plan. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS and Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS. Separate materials by one of the following methods described herein:

1.10.1 Source Separation Method

Separate waste products and materials that are recyclable from trash and sort as described below into appropriately marked separate containers and then transport to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse

facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the category types as defined in the construction waste management plan.

1.10.2 Co-Mingled Method

Place waste products and recyclable materials into a single container and then transport to an authorized recycling facility, which meets all applicable requirements to accept and dispose of recyclable materials in accordance with all applicable local, state and federal regulations. The Co-mingled materials must be sorted and processed in accordance with the approved construction waste management plan.

1.10.3 Other Methods

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.11 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures as described in the waste management plan. Except as otherwise specified in other sections of the specifications, dispose of in accordance with the following:

1.11.1 Reuse

Give first consideration to reusing construction and demolition materials as a disposition strategy. Recover for reuse materials, products, and components as described in the approved construction waste management plan. Coordinate with the Contracting Officer to identify onsite reuse opportunities or material sales or donation available through Government resale or donation programs. Sale of recovered materials is not allowed on the Installation.

1.11.2 Waste

Dispose by landfill or incineration only those waste materials with no practical use, economic benefit, or recycling opportunity.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

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SECTION 01 78 00

CLOSEOUT SUBMITTALS
05/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E1971 (2005; R 2011) Standard Guide for
Stewardship for the Cleaning of Commercial
and Institutional Buildings

GREEN SEAL (GS)

GS-37 (2017) Cleaning Products for Industrial
and Institutional Use

U.S. DEPARTMENT OF DEFENSE (DOD)

FC 1-300-09N (2014; with Change 4, 2018) Navy and
Marine Corps Design

UFC 1-300-08 (2009, with Change 2, 2011) Criteria for
Transfer and Acceptance of DoD Real
Property

1.2 DEFINITIONS

1.2.1 As-Built Drawings

As-built drawings are the marked-up drawings, maintained by the Contractor on-site, that depict actual conditions and deviations from the Contract Documents. These deviations and additions may result from coordination required by, but not limited to: contract modifications; official responses to submitted Requests for Information (RFI's); direction from the Contracting Officer; design that is the responsibility of the Contractor, and differing site conditions. Maintain the as-builts throughout construction as red-lined hard copies on site. These files serve as the basis for the creation of the record drawings.

1.2.2 Record Drawings

The record drawings are the final compilation of actual conditions reflected in the as-built drawings.

1.3 SOURCE DRAWING FILES

Request the full set of electronic drawings, in the source format, for Record Drawing preparation, after award and at least 30 days prior to required use.

1.3.1 Terms and Conditions

Data contained on these electronic files must not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse shall be at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor must make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor must, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic CAD drawing files are not construction documents. Differences may exist between the CAD files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic CAD files, nor does it make representation to the compatibility of these files with the Contractor hardware or software. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished Source drawing files, the signed and sealed construction documents govern. The Contractor is responsible for determining if any conflict exists. Use of these Source Drawing files does not relieve the Contractor of duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate the work of all contractors for the project. If the Contractor uses, duplicates or modifies these electronic source drawing files for use in producing construction data related to this contract, remove all previous indicia of ownership (seals, logos, signatures, initials and dates).

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Warranty Management Plan

Warranty Tags

Final Cleaning

Spare Parts Data

SD-08 Manufacturer's Instructions

Posted Instructions

SD-11 Closeout Submittals

As-Built Drawings; G

Record Drawings; G

As-Built Record of Equipment and Materials

Certification of EPA Designated Items; G

Certification Of USDA Designated Items; G

Interim DD FORM 1354; G

Checklist for DD FORM 1354; G

High Performance and Sustainable Building (HPSB) Checklist; G

1.5 SPARE PARTS DATA

Submit two copies of the Spare Parts Data list.

- a. Indicate manufacturer's name, part number, and stock level required for test and balance, pre-commissioning, maintenance and repair activities. List those items that may be standard to the normal maintenance of the system.

1.6 WARRANTY MANAGEMENT

1.6.1 Warranty Management Plan

Develop a warranty management plan which contains information relevant to FAR 52.246-21 Warranty of Construction. At least 30 days before the planned pre-warranty conference, submit one set of the warranty management plan. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan narrative must contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below must include due date and whether item has been submitted or was accomplished. Submit warranty information, made available during the construction phase, to the Contracting Officer for approval prior to each monthly pay estimate. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period must begin on the date of project acceptance and continue for the full product warranty period. Conduct a joint 4 month and 9 month warranty inspection, measured from time of acceptance; with the Contractor, Contracting Officer and the Customer Representative. The warranty management plan must include, but is not limited to, the following:

- a. Roles and responsibilities of personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.
- b. For each warranty, the name, address, telephone number, and e-mail of each of the guarantor's representatives nearest to the project location.
- c. A list and status of delivery of Certificates of Warranty for extended warranty items, including roofs, HVAC balancing, pumps, motors, transformers, and for commissioned systems, such as fire protection and alarm systems, sprinkler systems, and lightning protection systems.

- d. As-Built Record of Equipment and Materials list for each warranted equipment, item, feature of construction or system indicating:
 - (1) Name of item.
 - (2) Model and serial numbers.
 - (3) Location where installed.
 - (4) Name and phone numbers of manufacturers or suppliers.
 - (5) Names, addresses and telephone numbers of sources of spare parts.
 - (6) Warranties and terms of warranty. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have warranties longer than one year must be indicated with separate warranty expiration dates.
 - (7) Cross-reference to warranty certificates as applicable.
 - (8) Starting point and duration of warranty period.
 - (9) Summary of maintenance procedures required to continue the warranty in force.
 - (10) Cross-reference to specific pertinent Operation and Maintenance manuals.
 - (11) Organization, names and phone numbers of persons to call for warranty service.
 - (12) Typical response time and repair time expected for various warranted equipment.
- e. The plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.
- f. Procedure and status of tagging of equipment covered by warranties longer than one year.
- g. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty or safety reasons.

1.6.2 Performance Bond

The Performance Bond must remain effective throughout the construction and warranty period .

- a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.
- b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.
- c. Following oral or written notification of required construction warranty repair work, respond in a timely manner. Written verification will follow oral instructions. Failure to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.6.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, meet with the Contracting Officer to develop a mutual

understanding with respect to the requirements of this section. At this meeting, establish and review communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty. In connection with these requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact must be located within the local service area of the warranted construction, be continuously available, and be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.6.4 Warranty Tags

At the time of installation, tag each warranted item with a durable, oil and water resistant tag approved by the Contracting Officer. Attach each tag with a copper wire and spray with a silicone waterproof coating. Also, submit two record copies of the warranty tags showing the layout and design. The date of acceptance and the QC signature must remain blank until the project is accepted for beneficial occupancy. Show the following information on the tag.

Type of product/material	
Model number	
Serial number	
Contract number	
Warranty period from/to	
Inspector's signature	
Construction Contractor	
Address	
Telephone number	
Warranty contact	
Address	
Telephone number	

Warranty response time priority code	
WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.	

PART 2 PRODUCTS

2.1 CERTIFICATION OF EPA DESIGNATED ITEMS

Submit the Certification of EPA Designated Items as required by FAR 52.223-9 Estimate of Percentage of Recovered Material Content for EPA Designated Items and FAR 52-223-17 Affirmative Procurement of EPA designated items in Service and Construction Contracts. Include on the certification form the following information: project name, project number, Contractor name, license number, Contractor address, and certification. The certification will read as follows and be signed and dated by the Contractor. "I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content. The following exemptions may apply to the non-procurement of recycled/recovered content materials:

- a. The product does not meet appropriate performance standards;
- b. The product is not available within a reasonable time frame;
- c. The product is not available competitively (from two or more sources);
- d. The product is only available at an unreasonable price (compared with a comparable non-recycled content product)."

Record each product used in the project that has a requirement or option of containing recycled content in accordance with SECTION 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING, noting total price, total value of post-industrial recycled content, total value of post-consumer recycled content, exemptions (a, b, c, or d, as indicated), and comments. Recycled content values may be determined by weight or volume percent, but must be consistent throughout.

2.2 CERTIFICATION OF USDA DESIGNATED ITEMS

Submit the Certification of USDA Designated Items as required by FAR 52-223-1 Bio-based Product Certifications and FAR 52.223-2 Affirmative Procurement of Biobased Products Under Service and Construction Contracts. Include on the certification form the following information: project name, project number, Contractor name, license number, Contractor address, and certification. The certification will read as follows and be signed and dated by the Contractor. "I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current USDA standards for biobased materials content. The following exemptions may apply to the non-procurement of biobased content materials:

- a. The product does not meet appropriate performance standards;
- b. The product is not available within a reasonable time frame;

- c. The product is not available competitively (from two or more sources);
- d. The product is only available at an unreasonable price (compared with a comparable bio-based content product)."

Record each product used in the project that has a requirement or option of containing biobased content in accordance with SECTION 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING, noting total price, total value of post-industrial recycled content, total value of post-consumer recycled content, total value of biobased content, exemptions (a, b, c, or d, as indicated), and comments. Biobased content values may be determined by weight or volume percent, but must be consistent throughout.

PART 3 EXECUTION

3.1 AS-BUILT DRAWINGS

Provide and maintain two black line print copies of the PDF contract drawings for As-Built Drawings. Maintain the as-builts throughout construction as red-lined hard copies on site and red-lined PDF files. Submit As-Built Drawings 30 days prior to Beneficial Occupancy Date (BOD).

3.1.1 Markup Guidelines

Make comments and markup the drawings complete without reference to letters, memos, or materials that are not part of the As-Built drawing. Show what was changed, how it was changed, where item(s) were relocated and change related details. These working as-built markup prints must be neat, legible and accurate as follows:

- a. Use base colors of red, green, and blue. Color code for changes as follows:
 - (1) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes.
 - (2) Deletions (Red) - Over-strike deleted graphic items (lines), lettering in notes and leaders.
 - (3) Additions (Green) - Added items, lettering in notes and leaders.
- b. Provide a legend if colors other than the "base" colors of red, green, and blue are used.
- c. Add and denote any additional equipment or material facilities, service lines, incorporated under As-Built Revisions if not already shown in legend.
- d. Use frequent written explanations on markup drawings to describe changes. Do not totally rely on graphic means to convey the revision.
- e. Use legible lettering and precise and clear digital values when marking prints. Clarify ambiguities concerning the nature and application of change involved.
- f. Wherever a revision is made, also make changes to related section views, details, legend, profiles, plans and elevation views, schedules, notes and call out designations, and mark accordingly to avoid conflicting data on all other sheets.

- g. For deletions, cross out all features, data and captions that relate to that revision.
- h. For changes on small-scale drawings and in restricted areas, provide large-scale inserts, with leaders to the applicable location.
- i. Indicate one of the following when attaching a print or sketch to a markup print:
 - 1) Add an entire drawing to contract drawings
 - 2) Change the contract drawing to show
 - 3) Provided for reference only to further detail the initial design.
- j. Incorporate all shop and fabrication drawings into the markup drawings.

3.1.2 As-Built Drawings Content

Show on the as-built drawings, but not limited to, the following information:

- a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the record drawings. Locate valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Also record the average depth below the surface of each run.
- b. The location and dimensions of any changes within the building structure.
- c. Layout and schematic drawings of electrical circuits and piping.
- d. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.
- e. Changes in details of design or additional information obtained from working drawings specified to be prepared or furnished by the Contractor; including but not limited to shop drawings, fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment, and foundations.
- f. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.
- g. Changes or Revisions which result from the final inspection.
- h. Where contract drawings or specifications present options, show only the option selected for construction on the working as-built markup drawings.
- i. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, furnish a

contour map of the final borrow pit/spoil area elevations.

- j. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.
- k. Changes in location of equipment and architectural features.
- l. Modifications and compliance with FC 1-300-09N procedures.
- m. Actual location of anchors, construction and control joints, etc., in concrete.
- n. Unusual or uncharted obstructions that are encountered in the contract work area during construction.
- o. Location, extent, thickness, and size of stone protection particularly where it will be normally submerged by water.

3.2 RECORD DRAWINGS

Prepare and provide Record Drawings and Source Documents in accordance with FC 1-300-09N. Provide four copies of Record Drawings and Documents on separate CDs or DVDs 30 days after BOD.

3.3 CLEANUP

Provide final cleaning in accordance with ASTM E1971 and submit two copies of the listing of completed final clean-up items. Leave premises "broom clean." Comply with GS-37 for general purpose cleaning and bathroom cleaning. Use only nonhazardous cleaning materials, including natural cleaning materials, in the final cleanup. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Replace filters of operating equipment and comply with the Indoor Air Quality (IAQ) Management Plan. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site. Recycle, salvage, and return construction and demolition waste from project in accordance with Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS, and 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

3.4 REAL PROPERTY RECORD

Refer to UFC 1-300-08 for instruction on completing the DD FORM 1354. Contact the Contracting Officer for any project specific information necessary to complete the DD FORM 1354.

3.4.1 Interim DD FORM 1354

Near the completion of Project, but a minimum of 60 days prior to final acceptance of the work, complete and submit an accounting of all installed property with Interim DD FORM 1354. Include any additional assets, improvements, and alterations from the Draft DD FORM 1354.

3.4.2 Completed DD FORM 1354

Attach the Real Property receiving Component's completed High Performance

and Sustainable Building (HPSB) Checklist for each applicable building to the completed DD 1354, in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING. For convenience, a blank fillable PDF DD FORM 1354 may be obtained at the following link:

www.esd.whs.mil/Portals/54/Documents/DD/forms/dd/dd1354.pdf

Submit the completed Checklist for DD FORM 1354 of Installed Building Equipment items. Attach this list to the updated DD FORM 1354.

-- End of Section --

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

08/15, CHG 1: 11/20

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-10 Operation and Maintenance Data

Training Plan; G

Training Outline; G

Training Content; G

SD-11 Closeout Submittals

Training Video Recording; G

Validation of Training Completion; G

1.2 OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data for the provided equipment, product, or system, defining the importance of system interactions, troubleshooting, and long-term preventive operation and maintenance. Compile, prepare, and aggregate O&M data to include clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.2.1 Package Quality

Documents must be fully legible. Operation and Maintenance data must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions.

1.2.2 Package Content

Provide data package content in accordance with paragraph SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES. Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Use Data Package 4 for commissioned items without a specified data package requirement in the individual technical sections. Provide a Data Package 4 instead of Data Package 1 or 2, as specified in the individual technical section, for items that are commissioned.

1.2.3 Changes to Submittals

Provide manufacturer-originated changes or revisions to submitted data if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

1.2.4 Commissioning Authority Review and Approval

Submit the commissioned systems and equipment submittals to the Commissioning Authority (CxA) to review for completeness and applicability. Obtain validation from the CxA that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. The CxA communicates deficiencies to the Contracting Officer. Submit the O&M manuals to the Contracting Officer upon a successful review of the corrections, and with the CxA recommendation for approval and acceptance of these O&M manuals. This work is in addition to the normal review procedures for O&M data.

1.3 OPERATION AND MAINTENANCE MANUAL FILE FORMAT

Assemble data packages into electronic Operation and Maintenance Manuals. Assemble each manual into a composite electronically indexed file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Provide compact disks (CD) or data digital versatile disk (DVD) as appropriate, so that each one contains operation, maintenance and record files, project record documents, and training videos. Include a complete electronically linked operation and maintenance directory.

1.3.1 Organization

Bookmark Product and Drawing Information documents using the current version of CSI MasterFormat numbering system, and arrange submittals using the specification sections as a structure. Use CSI MasterFormat and UFGS numbers along with descriptive bookmarked titles that explain the content of the information that is being bookmarked.

1.3.2 CD or DVD Label and Disk Holder or Case

Provide the following information on the disk label and disk holder or case:

- a. Building Number
- b. Project Title
- c. Activity and Location
- d. Construction Contract Number
- e. Prepared For: (Contracting Agency)
- f. Prepared By: (Name, title, phone number and email address)

- g. Include the disk content on the disk label
- h. Date
- i. Virus scanning program used

1.4 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

The following are a detailed description of the data package items listed in paragraph SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES.

1.4.1 Operating Instructions

Provide specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.4.1.1 Safety Precautions and Hazards

List personnel hazards and equipment or product safety precautions for operating conditions. List all residual hazards identified in the Activity Hazard Analysis provided under Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS. Provide recommended safeguards for each identified hazard.

1.4.1.2 Operator Prestart

Provide procedures required to install, set up, and prepare each system for use.

1.4.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.4.1.4 Normal Operations

Provide Control Diagrams with data to explain operation and control of systems and specific equipment. Provide narrative description of Normal Operating Procedures.

1.4.1.5 Emergency Operations

Provide Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Provide Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.4.1.6 Operator Service Requirements

Provide instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gauge readings.

1.4.1.7 Environmental Conditions

Provide a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each

product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.4.1.8 Operating Log

Provide forms, sample logs, and instructions for maintaining necessary operating records.

1.4.1.9 Additional Requirements for HVAC Control Systems

Provide Data Package 5 and the following for control systems:

- a. Narrative description on how to perform and apply functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.
- b. Full as-built sequence of operations.
- c. Copies of checkout tests and calibrations performed by the Contractor (not Cx tests).
- d. Full points list. Provide a listing of rooms with the following information for each room:
 - (1) Floor
 - (2) Room number
 - (3) Room name
 - (4) Air handler unit ID
 - (5) Reference drawing number
 - (6) Air terminal unit tag ID
 - (7) Heating or cooling valve tag ID
 - (8) Minimum cfm
 - (9) Maximum cfm
- e. Full print out of all schedules and set points after testing and acceptance of the system.
- f. Full as-built print out of software program.
- g. Marking of system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.4.2 Preventive Maintenance

Provide the following information for preventive and scheduled maintenance to minimize repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.4.2.1 Lubrication Data

Include the following preventive maintenance lubrication data, in addition to instructions for lubrication required under paragraph OPERATOR SERVICE REQUIREMENTS:

- a. A table showing recommended lubricants for specific temperature ranges and applications.
- b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.
- c. A Lubrication Schedule showing service interval frequency.

1.4.2.2 Preventive Maintenance Plan, Schedule, and Procedures

Provide manufacturer's schedule for routine preventive maintenance, inspections, condition monitoring (predictive tests) and adjustments required to ensure proper and economical operation and to minimize repairs. Provide instructions stating when the systems should be retested. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

- a. Define the anticipated time required to perform each of each test (work-hours), test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize repairs.
- b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.4.3 Repair

Provide manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.4.3.1 Troubleshooting Guides and Diagnostic Techniques

Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.4.3.2 Wiring Diagrams and Control Diagrams

Provide point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.4.3.3 Repair Procedures

Provide instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.4.3.4 Removal and Replacement Instructions

Provide step-by-step procedures and a list of required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Use a combination of text and illustrations.

1.4.3.5 Spare Parts and Supply Lists

Provide lists of spare parts and supplies required for repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.4.3.6 Repair Work-Hours

Provide manufacturer's projection of repair work-hours including requirements by type of craft. Identify, and tabulate separately, repair that requires the equipment manufacturer to complete or to participate.

1.4.4 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.4.4.1 Product Submittal Data

Provide a copy of SD-03 Product Data submittals documented with the required approval.

1.4.4.2 Certificates

Provide a copy of SD-07 Certificates submittals documented with the required approval.

1.4.4.3 Manufacturer's Instructions

Provide a copy of SD-08 Manufacturer's Instructions submittals documented with the required approval.

1.4.4.4 O&M Submittal Data

Provide a copy of SD-10 Operation and Maintenance Data submittals

documented with the required approval.

1.4.4.5 Parts Identification

Provide identification and coverage for the parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing must show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Group the parts shown in the listings by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog.

1.4.4.6 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components of the system. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.4.4.7 Extended Warranty Information

List all warranties for products, equipment, components, and sub-components whose duration exceeds one year. For each warranty listed, indicate the applicable specification section, duration, start date, end date, and the point of contact for warranty fulfillment. Also, list or reference the specific operation and maintenance procedures that must be performed to keep the warranty valid. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.4.4.8 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.4.4.9 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components. Provide final set points.

1.4.4.10 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms. Provide final set points.

1.4.4.11 Field Test Reports and Manufacturer's Field Reports

Provide a copy of Field Test Reports (SD-06) and Manufacturer's Field

Reports (SD-09) submittals documented with the required approval.

1.4.4.12 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.5 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Provide the O&M data packages specified in individual technical sections. The information required in each type of data package follows:

1.5.1 Data Package 4

- a. Safety precautions and hazards
- b. Operator prestart
- c. Startup, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Operator service requirements
- g. Environmental conditions
- h. Operating log
- i. Lubrication data
- j. Preventive maintenance plan, schedule, and procedures
- k. Cleaning recommendations
- l. Troubleshooting guides and diagnostic techniques
- m. Wiring diagrams and control diagrams
- n. Repair procedures
- o. Removal and replacement instructions
- p. Spare parts and supply list
- q. Repair work-hours
- r. Product submittal data
- s. O&M submittal data
- t. Parts identification

- u. Warranty information
- v. Extended warranty information
- w. Personnel training requirements
- x. Testing equipment and special tool information
- y. Testing and performance data
- z. Contractor information
- aa. Field test reports

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TRAINING

Prior to acceptance of the facility by the Contracting Officer for Beneficial Occupancy, provide comprehensive training for the systems and equipment specified in the technical specifications. The training must be targeted for the building maintenance personnel, and applicable building occupants. Instructors must be well-versed in the particular systems that they are presenting. Address aspects of the eOMSI Manual, as submitted in Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Training must include classroom or field lectures based on the system operating requirements. The location of classroom training requires approval by the Contracting Officer.

3.1.1 Training Plan

Submit a written training plan to the Contracting Officer for approval at least 60 calendar days prior to the scheduled training. Training plan must be approved by the Commissioning Authority (CxA) prior to forwarding to the Contracting Officer. Also, coordinate the training schedule with the Contracting Officer and CxA. Include within the plan the following elements:

- a. Equipment included in training
- b. Intended audience
- c. Location of training
- d. Dates of training
- e. Objectives
- f. Outline of the information to be presented and subjects covered including description
- g. Start and finish times and duration of training on each subject
- h. Methods (e.g. classroom lecture, video, site walk-through, actual operational demonstrations, written handouts)

- i. Instructor names and instructor qualifications for each subject
- j. List of texts and other materials to be furnished by the Contractor that are required to support training
- k. Description of proposed software to be used for video recording of training sessions.

3.1.2 Training Content

The core of this training must be based on manufacturer's recommendations and the operation and maintenance information. The CxA is responsible for overseeing and approving the content and adequacy of the training. Provide a brief summary of the FACILITY INFORMATION manual, and a more detailed presentation of the PRODUCT AND DRAWING MANUAL, specified in Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Spend 95 percent of the instruction time during the presentation on the OPERATION AND MAINTENANCE DATA. Include the following for each system training presentation:

- a. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms.
- b. Relevant health and safety issues.
- c. Discussion of how the feature or system is environmentally responsive. Advise adjustments and optimizing methods for energy conservation.
- d. Design intent.
- e. Use of O&M Manual Files.
- f. Review of control drawings and schematics.
- g. Interactions with other systems.
- h. Special maintenance and replacement sources.
- i. Tenant interaction issues.

3.1.3 Training Outline

Provide the eOMSI Manual files as specified in Section 01 78 24.00 20, FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI), and a written course outline listing the major and minor topics to be discussed by the instructor on each day of the course to each trainee in the course. Provide the course outline 14 calendar days prior to the training.

3.1.4 Training Video Recording

Record classroom training session(s) on video. Provide to the Contracting Officer two copies of the training session(s) in DVD video recording format. Capture within the recording, in video and audio, the instructors' training presentations including question and answer periods with the attendees. The recording camera(s) must be attended by a person

during the recording sessions to assure proper size of exhibits and projections during the recording are visible and readable when viewed as training.

3.1.5 Unresolved Questions from Attendees

If, at the end of the training course, there are questions from attendees that remain unresolved, the instructor must send the answers, in writing, to the Contracting Officer for transmittal to the attendees, and the training video must be modified to include the appropriate clarifications.

3.1.6 Validation of Training Completion

Ensure that each attendee at each training session signs a class roster daily to confirm Government participation in the training. At the completion of training, submit a signed validation letter that includes a sample record of training for reporting what systems were included in the training, who provided the training, when and where the training was performed, and copies of the signed class rosters. Provide two copies of the validation to the Contracting Officer, and one copy to the Operation and Maintenance Manual Preparer for inclusion into the Manual's documentation.

3.1.7 Quality Control Coordination

Coordinate this training with the CxA in accordance with Section 01 45 00.00 20 QUALITY CONTROL.

-- End of Section --

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SECTION 01 78 24.00 20

FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI)
02/15, CHG 2: 11/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD)

FC 1-300-09N (2014; with Change 4, 2018) Navy and
Marine Corps Design

1.2 DEFINITIONS AND ABBREVIATIONS

1.2.1 eOMSI Manual

Manual (PDF file) provided by the Contractor that includes, but is not limited to, product information, a facility description with photos, and a list of primary facility systems.

1.2.2 eOMSI Facility Data Workbook (FDW)

A Microsoft Excel file containing required facility information populated by the Contractor.

1.2.3 Systems

The words "system", "systems", and "equipment", when used in this document refer to as-built systems and equipment.

1.2.4 Computer Assisted Design and Drafting (CADD)

Electronic Computer Assisted Design and Drafting graphic software program that is used to create facility design contract documents and Record Drawings.

1.2.5 KTR

An abbreviation for "Contractor."

1.3 eOMSI MEETINGS

1.3.1 Pre-Construction Meeting

Be prepared to discuss the following during this meeting:

- a. eOMSI Manual and eOMSI Facility Data Workbook Coordination Meeting
- b. Processes and methods of gathering eOMSI Manual and eOMSI Facility Data Workbook information during construction.
- c. The eOMSI Submittals schedule. Include the eOMSI submittal schedule

on the Baseline Network Analysis Schedule (NAS) in accordance with
Section 01 32 17.00 20 COST-LOADED NETWORK ANALYSIS SCHEDULE (NAS).

- d. Electronic eOMSI Facility Data Workbook file for Contractor's use and completion.

1.3.2 eOMSI Manual and Facility Data Workbook Coordination Meeting

Facilitate a meeting after the Pre-Construction Meeting prior to the submission of the eOMSI Progress Submittal. Meeting attendance must include the Contractor's eOMSI Manual and Facility Data Workbook Preparer, and Quality Control Manager, the Commissioning Authority (CxA), and the Government's Design Manager (DM), Contracting Officer's Representative, and NAVFAC Public Works (PW) Facilities Management Division (FMD). Include any Mechanical, Electrical, and Fire Protection Sub-Contractors.

The purpose of this meeting is to reach a mutual understanding of the scope of work concerning the contract requirements for eOMSI and coordinate the efforts necessary by both the Government and Contractor to ensure an accurate collection, preparation and timely Government review of eOMSI.

1.3.3 Facility Turnover Meeting

Include eOMSI in NAVFAC Red Zone (NRZ) facility turnover meetings as specified in Section 01 30 00, ADMINISTRATIVE REQUIREMENTS.

1.4 SUBMITTAL SCHEDULING

1.4.1 eOMSI, Progress Submittal

Submit the Progress submittal when construction is approximately 50 percent complete, to the Contracting Officer for approval. Provide eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel). Include the elements and portions of system construction completed up to this point.

The purpose of this submittal is to verify progress is in accordance with contract requirements as discussed during the eOMSI Manual Coordination Meeting. Field verify a portion of the eOMSI information in accordance with paragraph FIELD VERIFICATION.

1.4.2 eOMSI, Prefinal Submittal

Submit the 100 percent submittal of the eOMSI Prefinal Submittal to the Contracting Officer for approval within 90 calendar days of the Beneficial Occupancy Date (BOD). This submittal must provide a complete, working document that can be used to operate and maintain the facility. Any portion of the submittal that is incomplete or inaccurate requires the entire submittal to be returned for correction. Any discrepancies discovered during the Government's review of eOMSI Progress submittal must be corrected prior to the Prefinal submission.

The eOMSI Prefinal Submittal must include eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel).

1.4.3 eOMSI, Final Submittal

Submit completed eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility

Data Workbook (Excel). The Final submittal is due at BOD. Any discrepancies discovered during the Government's review of the Prefinal eOMSI submittal, including the Field Verification, must be corrected prior to the Final eOMSI submission.

1.5 UNITS OF MEASURE

Provide eOMSI utilizing the units of measure used in the Government generated contract documents.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

eOMSI, Progress Submittal; G

eOMSI, Prefinal Submittal; G

eOMSI, Final Submittal; G

PART 2 PRODUCTS

2.1 eOMSI FILES FORMAT

Format eOMSI manuals and files in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Include a complete electronically linked operation and maintenance directory. Provide four electronic copies of the eOMSI Manuals to the Contracting Officer for approval.

Provide eOMSI Facility Data Workbook on compact disks (CD) or data digital versatile disk (DVD) disks in (EXCEL) format. Scan eOMSI Manual Files and eOMSI Facility Data Workbook for viruses, malware, and spyware using a commercially available scanning program that is routinely updated to identify and remove current virus threats.

2.1.1 eOMSI Manual Organization

Organize the eOMSI Manuals into two parts: 1) Product and Drawing Information, and 2) Facility Information. Bookmark the PDF files for easy access to the information.

- a. Bookmark Product and Drawing Information documents in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.
- b. Bookmark Facility Information to at least one level lower than the major system.

2.1.2 eOMSI Manual CD or DVD Disk Label and Disk Holder or Case

Provide disks in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

2.2 eOMSI MANUAL

2.2.1 Product and Drawing Information

Provide an organized record of the facility products, materials, equipment, and testing submittals, and the minimum information necessary to operate the facility. Provide Product and Drawing Information for the systems of the final constructed facility.

2.2.1.1 O&M Data

As a minimum, provide the approved O&M Data, submitted in the technical specification sections, in accordance with paragraph TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES in Section 01 78 23 OPERATION AND MAINTENANCE DATA.

2.2.1.2 Record Drawings

Provide an electronic, PDF copy of the Record Drawings, prepared in accordance with FC 1-300-09N and 01 78 00 CLOSEOUT SUBMITTALS. Bookmark drawings using the sheet title and sheet number.

Include Record Drawings as part of the Red-Zone specified in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS.

2.2.1.3 Utility Record Drawings

Using Record Source Drawings, show and document details of the actual installation of the utility systems; annotate and highlight the eOMSI information. Provide Utility Record Drawings in PDF format. Provide the following drawings at a large enough scale to differentiate designated isolation units from surrounding valves and switches.

- a. Utility Schematic Diagrams - Provide a one line schematic diagram for each utility system such as power, water, wastewater, and gas/fuel. Schematic diagram must show from the point where the utility line is connected to the mainline up to the five-foot connection point to the facility. Indicate location or area designation for route of transmission or distribution lines; locations of duct banks, manholes/ handholes or poles; isolation units such as valves and switches; and utility facilities such as pump stations, lift stations, and substations.
- b. Enlarged Connection and Cutoff Plans - Provide enlarged floor plans that provide information between the five foot utility connection point and where utilities connect to facility distribution. Enlarge floor plans/ elevations of the rooms where the utility enters the building and indicate on these plans locations of the main interior and exterior connection and cutoff points for the utilities. Also enlarge floor plans / elevations of the rooms where equipment is located. Include enough information to enable someone unfamiliar with the facility to locate the connection and cutoff points. Indicate designations such as room number, panel number, circuit breaker, or valve number, of each utility and equipment connection and cutoff point, and what that connection and cutoff point controls.

2.2.2 Facility Information

Provide the following in Facility Information:

2.2.2.1 General Facility and System Description

Describe the function of the facility. Detail the overall dimensions of the facility, number of floors, foundation type, expected number of occupants, and facility Category Code. List and generally describe all the facility systems and any special building features (for example, HVAC Controls, Sprinkler Systems, Cranes, Elevators, and Generators). Include photographs marked up and labeled to show key operating components and the overall facility appearance.

2.2.2.2 Floor Plans

Provide uncluttered, legible 11 by 17 inches floor plans. Include room numbers, type or function of spaces, and overall facility dimensions on the floor plans. Do not include items such as construction instructions, references, or frame numbers.

2.2.2.3 Floor Coverings, Wall Surfaces, and Ceiling Surfaces

Provide a table that lists by room number (including hallways and common spaces), the type, and area of finish, manufacturer's product name, identifying number, and color. Include a facility summary of the total area for each type of space and floor, wall, or ceiling finish in the table.

2.2.2.4 Windows

Provide a table that lists by room number (including hallways and common spaces), the type of window, window size, number of each size and type, special features, manufacturer's product name, identifying number, and color. The table must include a facility summary of the total number for each type and size of window.

2.2.2.5 Roofing

Provide the total area of each type of roof surface and system. Provide the name of the roofing product and system; manufacturer's, supplier's, and installer's names, addresses, and phone numbers; manufacturer's product name, identifying number, and color. For each type of roof, provide a recommended inspection, maintenance and repair schedule that details checkpoints, frequencies, and prohibited practices. List roof structural load limits.

2.2.2.6 HVAC Filters

Provide a table that lists the quantity, type, size, and location of each HVAC filter, manufacturer's product name, and identifying number.

2.2.2.7 Plumbing Fixtures

Provide a table that lists by room number, the number and type of plumbing and bathroom plumbing fixtures (for example, sinks, water closets, urinals, showers and drinking fountains).

2.2.2.8 Lighting Fixtures

Provide a table that lists by room number (including hallways and common spaces), the type of lighting fixture, ballast, number of lighting

fixtures, type of lamps and number of lamps, and the manufacturer's product name and the identifying number. The table must include a facility summary of the total number of fixtures of each type and number of lamps of each type.

2.2.2.9 Equipment Listing

Provide a table that lists the major equipment shown on the design equipment schedules. Show the item descriptions, locations, model numbers; and the names, addresses, and telephone numbers of the manufacturers, suppliers, contractors, and subcontractors.

2.2.2.10 System Flow Diagrams

Provide a flow diagram indicating system liquid, air or gas flow during normal operations. Integrate the system components into the diagram. A compilation of non-integrated, flow diagrams for the individual system components are not acceptable.

2.2.2.11 Valve List

Provide a list of all valves associated with the system. Show valve type, identification number, function, location and normal operating position.

2.2.2.12 Riser Diagrams

Provide riser diagrams and settings of equipment.

2.3 eOMSI FACILITY DATA WORKBOOK

An initial, pre-edited draft of the Model & Facility Data Matrix tab within the eOMSI Facility Data Workbook is attached to this section. The Government will provide this eOMSI Facility Data Workbook electronically to the Contractor upon award. Add, delete, and update Mastersystems, Systems, and Subsystems that may have changed during construction, or any items that may have been omitted or missed during design, at no additional cost to the Government. Complete the KTR Facility Data File tab based on the selection of Mastersystems, Systems, and Subsystems installed. The following tabs are included in the eOMSI Facility Data File Workbook and serve the purpose stated:

- a. Instructions Tab: Instructions for completing Model & Facility Data Matrix Tab and KTR Facility Data File Tab. If a discrepancy exists between what is required in this section and the Workbook, the instructions within the workbook take precedence.
- b. Model & Facility Data Matrix Tab: - The Matrix lists Required Facility Asset Fields for each SYSTEM and SUBSYSTEM. The Designer of Record selects SYSTEMS and SUBSYSTEMS that are within the project scope, which the Contractor needs to include and populate in KTR Facility Data File tab. The "Required Facility Asset Field Position Numbers," one through thirty-five, are pre-populated, and are not editable.
- c. Required Facility Asset Fields Tab: Defines the 35 Required Facility Asset Field Position Numbers used in Model and Facility Data Matrix and KTR Facility Data File tabs.
- d. KTR Sample Facility Data File Tab: Sample KTR eOMSI facility data file. This tab provides an example of the mandatory fields of

equipment installed by the Contractor, and populated in the KTR eOMSI Facility Data File Tab, along with their descriptions.

- e. KTR Facility Data File Tab: Required eOMSI facility data file deliverable provided to the Government. Provide a separate and unique new row for each facility component or piece of equipment installed. Coordinate with the Government's Contracting Officer's Representative and NAVFAC PW FMD for specific facility component naming convention.

PART 3 EXECUTION

3.1 FIELD VERIFICATION

Field verify eOMSI Facility Data Workbook information with Contractor and Government personnel. Include the following personnel in this meeting: Contractor's eOMSI Manual and Facility Data Workbook Preparer and Quality Control Manager, Commissioning Authority, and the Government's Contracting Officer's Representative and NAVFAC PW FMD. Request, and provide, an eOMSI Field Verification Meeting no sooner than 14 calendar days after submission of the Progress eOMSI submittal, and another, no sooner than 14 calendar days after submission of the Prefinal eOMSI submittal. During this meeting, the Government and Contractor will verify that the eOMSI Facility Data Workbook is complete and accurate.

Field verify that at least 5 Subsystems under each of the Mastersystems are accurate, for a total of 25 Subsystems. For each of these items, verify that the required facility asset field, as defined in the "Model & Facility Data Matrix" tab, contains the specified data and it is accurate (i.e. item description, manufacturer, model no., serial no.). 100 percent accuracy of eOMSI information is required for successful field verification. If data discrepancies are discovered amongst the 25 Subsystems verified, resubmit an updated eOMSI FDW, and request a make-up field verification meeting. At the make-up field verification meeting 25 new Subsystems and their associated required facility asset fields will be field verified; the 25 new Subsystems must be 100% accurate. Any discrepancies discovered must be corrected prior to next eOMSI Facility Data Workbook Submittal.

- (1) D10 - CONVEYING
- (2) D20 - PLUMBING
- (3) D30 - HVAC
- (4) D40 - FIRE PROTECTION
- (5) D50 - ELECTRICAL

3.2 eOMSI TRAINING

Provide training on eOMSI Manuals and Facility Data Workbook in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

-- End of Section --

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STEP 1: Is This a BIM Project?					No	Modeling Requirements			
STEP 2: Select Yes or No in Column E for each MASTERSYSTEM, SYSTEM and SUBSYSTEM that is In the Project Scope					In Scope (Yes or No)	DESIGN MODEL			RECORD MODEL
CLASSIFICATION ID	MASTERSYSTEM / SYSTEM / SUBSYSTEM Name	System Type	UOM	DISCIPLINE		LOD	GRADE	GRADE	
A10	A10 - FOUNDATIONS	MASTERSYSTEM	•	Yes	•	•	•	•	
A1010	STANDARD FOUNDATIONS	SYSTEM	•	Yes	•	•	•	•	
A1010110	A1010110 - STRIP FOOTINGS	SUBSYSTEM	LF	Yes	STRUCTURAL	300	A	A+	
A1010210	A1010210 - SPREAD FOOTINGS	SUBSYSTEM	EA	Yes	STRUCTURAL	300	A	A+	
A1010250	A1010250 - PILE CAPS	SUBSYSTEM	EA	Yes	STRUCTURAL	300	A	A+	
A1020	A1020 - SPECIAL FOUNDATIONS	SYSTEM	•	Yes	•	•	•	•	
A1020140	A1020140 - STEEL H PILES	SUBSYSTEM	EA	Yes	STRUCTURAL	300	A	A+	
A1020210	A1020210 - GRADE BEAMS	SUBSYSTEM	LF	Yes	STRUCTURAL	300	A	A+	
A1030	A1030 - SLAB ON GRADE	SYSTEM	•	Yes	•	•	•	•	
A1030120	A1030120 - PLAIN/REINFORCED	SUBSYSTEM	SF	Yes	STRUCTURAL	300	A	A+	
B10	B10 - SUPERSTRUCTURE	MASTERSYSTEM	•	Yes	•	•	•	•	
B1010	B1010 - FLOOR CONSTRUCTION	SYSTEM	•	Yes	•	•	•	•	
B1010250	B1010250 - COMPOSITE DECK, STEEL BAR JOISTS	SUBSYSTEM	SF	Yes	STRUCTURAL	300	A	A+	
B1010254	B1010254 - COMP DECK, STRUCTURAL STEEL BEAM	SUBSYSTEM	SF	Yes	STRUCTURAL	300	A	A+	
B1020	B1020 - ROOF CONSTRUCTION	SYSTEM	•	Yes	•	•	•	•	
B1020108	B1020108 - STEEL DECK, BEAMS AND BAR JOIST	SUBSYSTEM	SF	Yes	STRUCTURAL	300	A	A+	
B1020137	B1020137 - AWNING/CANOPY	SUBSYSTEM	SF	Yes	STRUCTURAL	300	A	A+	
B20	B20 - EXTERIOR ENCLOSURE	MASTERSYSTEM	•	Yes	•	•	•	•	
B2010	B2010 - EXTERIOR WALLS	SYSTEM	•	Yes	•	•	•	•	
B2010109	B2010109 - CONCRETE BLOCK	SUBSYSTEM	SF	Yes	STRUCTURAL	300	A	A+	
B2010146	B2010146 - METAL SIDING PANEL	SUBSYSTEM	SF	Yes	ARCHITECTURAL	300	A	A+	
B2020	B2020 - EXTERIOR GLAZED OPENINGS	SYSTEM	•	Yes	•	•	•	•	
B2020106	B2020106 - ALUMINUM WINDOWS	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
B2020210	B2020210 - TUBULAR ALUMINUM FRAMING	SUBSYSTEM	SF	Yes	ARCHITECTURAL	300	A	A+	
B2030	B2030 - EXTERIOR DOORS	SYSTEM	•	Yes	•	•	•	•	
B2030110	B2030110 - GLAZED DOORS	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
B2030210	B2030210 - WOOD DOORS	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
B2030220	B2030220 - STEEL DOORS	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
B2030230	B2030230 - ALUMINUM DOORS	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
B2030410	B2030410 - OVERHEAD DOORS	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
B30	B30 - ROOFING	MASTERSYSTEM	•	Yes	•	•	•	•	
B3010	B3010 - ROOF COVERING	SYSTEM	•	Yes	•	•	•	•	
B3010105	B3010105 - BUILT-UP	SUBSYSTEM	SF	Yes	ARCHITECTURAL	200	A	A+	
B3010130	B3010130 - PREFORMED METAL	SUBSYSTEM	SF	Yes	ARCHITECTURAL	200	A	A+	
B3010135	B3010135 - FORMED METAL	SUBSYSTEM	SF	Yes	ARCHITECTURAL	200	A	A+	
B3010320	B3010320 - ROOF DECK INSULATION	SUBSYSTEM	SF	Yes	ARCHITECTURAL	200	A	A+	
B3010610	B3010610 - GUTTERS	SUBSYSTEM	LF	Yes	ARCHITECTURAL	200	A	A+	
B3010620	B3010620 - DOWNSPOUTS	SUBSYSTEM	LF	Yes	ARCHITECTURAL	200	A	A+	
B3020	B3020 - ROOF OPENING	SYSTEM	•	Yes	•	•	•	•	
B3020210	B3020210 - HATCHES	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
C10	C10 - INTERIOR CONSTRUCTION	MASTERSYSTEM	•	Yes	•	•	•	•	
C1010	C1010 - PARTITIONS	SYSTEM	•	Yes	•	•	•	•	
C1010102	C1010102 - CONCRETE BLOCK	SUBSYSTEM	SF	Yes	ARCHITECTURAL	300	A	A+	
C1010120	C1010120 - TILE	SUBSYSTEM	SF	Yes	ARCHITECTURAL	300	A	A+	
C1010126	C1010126 - DRYWALL W/STUD FRAMING	SUBSYSTEM	SF	Yes	ARCHITECTURAL	300	A	A+	
C1010710	C1010710 - INTERIOR WINDOWS	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
C1020	C1020 - INTERIOR DOORS	SYSTEM	•	Yes	•	•	•	•	
C1020111	C1020111 - FIRE DOOR, SWINGING	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
C1020114	C1020114 - METAL DOOR	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
C1020122	C1020122 - WOOD DOOR/METAL FRAME	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
C1020124	C1020124 - WOOD FIRE DOORS/METAL FRAMES	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
C1030	C1030 - FITTINGS	SYSTEM	•	Yes	•	•	•	•	
C1030110	C1030110 - TOILET PARTITIONS	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
C1030310	C1030310 - LOCKERS	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+	
C1030830	C1030830 - CABINETS	SUBSYSTEM	LF	Yes	ARCHITECTURAL	300	A	A+	
C1030831	C1030831 - COUNTERTOP	SUBSYSTEM	LF	Yes	ARCHITECTURAL	300	A	A+	
C20	C20 - STAIRS	MASTERSYSTEM	•	Yes	•	•	•	•	
C2010	C2010 - STAIR CONSTRUCTION	SYSTEM	•	Yes	•	•	•	•	
C2010110	C2010110 - STAIRS	SUBSYSTEM	FLIGHT	Yes	ARCHITECTURAL	300	A	A+	
C2020	C2020 - STAIR FINISHES	SYSTEM	•	Yes	•	•	•	•	

C30	C30 - INTERIOR FINISHES	MASTERSYSTEM	●	Yes	●	●	●	●
C3010	C3010 - WALL FINISHES	SYSTEM	●	Yes	●	●	●	●
C3010230	C3010230 - WALL COVERING	SUBSYSTEM	SF	Yes	ARCHITECTURAL	100	B	B+
C3010380	C3010380 - WALL TILE	SUBSYSTEM	SF	Yes	ARCHITECTURAL	100	B	B+
C3020	C3020 - FLOORING	SYSTEM	●	Yes	●	●	●	●
C3020902	C3020902 - CARPET TILE	SUBSYSTEM	SF	Yes	ARCHITECTURAL	100	B	B+
C3020904	C3020904 - CONCRETE TOPPING	SUBSYSTEM	SF	Yes	ARCHITECTURAL	100	B	B+
C3020907	C3020907 - VINYL TILE	SUBSYSTEM	SF	Yes	ARCHITECTURAL	100	B	B+
C3020910	C3020910 - PORCELAIN TILE	SUBSYSTEM	SF	Yes	ARCHITECTURAL	100	B	B+
C3020912	C3020912 - PAINT	SUBSYSTEM	SF	Yes	ARCHITECTURAL	100	B	B+
C3030	C3030 - CEILING FINISHES	SYSTEM	●	Yes	●	●	●	●
C3030110	C3030110 - DRYWALL	SUBSYSTEM	SF	Yes	ARCHITECTURAL	200	A	A+
C3030210	C3030210 - ACOUSTICAL	SUBSYSTEM	SF	Yes	ARCHITECTURAL	200	A	A+
D10	D10 - CONVEYING	MASTERSYSTEM	●	Yes	●	●	●	●
D1010	D1010 - ELEVATORS AND LIFTS	SYSTEM	●	Yes	●	●	●	●
D1010110	D1010110 - HYDRAULIC ELEVATORS	SUBSYSTEM	EA	Yes	ARCHITECTURAL	300	A	A+
D20	D20 - PLUMBING	MASTERSYSTEM	●	Yes	●	●	●	●
D2010	D2010 - PLUMBING FIXTURES	SYSTEM	●	Yes	●	●	●	●
D2010110	D2010110 - TOILET	SUBSYSTEM	EA	Yes	PLUMBING	300	A	A+
D2010310	D2010310 - LAVATORY	SUBSYSTEM	EA	Yes	PLUMBING	300	A	A+
D2010410	D2010410 - SINK	SUBSYSTEM	EA	Yes	PLUMBING	300	A	A+
D2010710	D2010710 - SHOWER	SUBSYSTEM	EA	Yes	PLUMBING	300	A	A+
D2010820	D2010820 - WATER COOLER	SUBSYSTEM	EA	Yes	PLUMBING	300	A	A+
D2010901	D2010901 - EMERGENCY SHOWER	SUBSYSTEM	EA	Yes	PLUMBING	300	A	A+
D2010902	D2010902 - EMERGENCY EYE WASH	SUBSYSTEM	EA	Yes	PLUMBING	300	A	A+
D2020	D2020 - DOMESTIC WATER DISTRIBUTION	SYSTEM	●	Yes	●	●	●	●
D2020250	D2020250 - WATER HEATERS, COMMERCIAL, GAS	SUBSYSTEM	EA	Yes	PLUMBING	300	A	A+
D2020903	D2020903 - BACKFLOW PREVENTER	SUBSYSTEM	EA	Yes	PLUMBING	300	A	A+
D2020905	D2020905 - PIPING/FITTINGS	SUBSYSTEM	LF	Yes	PLUMBING	300	A	A+
D2030	D2030 - SANITARY WASTE	SYSTEM	●	Yes	●	●	●	●
D2030902	D2030902 - WASTE/VENT PIPING	SUBSYSTEM	LF	Yes	PLUMBING	300	A	A+
D2030905	D2030905 - SUMP PUMP	SUBSYSTEM	EA	Yes	PLUMBING	300	A	A+
D30	D30 - HVAC	MASTERSYSTEM	●	Yes	●	●	●	●
D3010	D3010 - ENERGY SUPPLY	SYSTEM	●	Yes	●	●	●	●
D3020	D3020 - HEAT GENERATING SYSTEMS	SYSTEM	●	Yes	●	●	●	●
D3020130	D3020130 - BOILER CAST IRON HOT WATER GAS	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3020906	D3020906 - EXPANSION TANK	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3030	D3030 - COOLING GENERATING SYSTEMS	SYSTEM	●	Yes	●	●	●	●
D3030223	D3030223 - SPLIT DUCTLESS HEAT PUMP , OUTDOOR UNIT	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3030223	D3030223 - SPLIT DUCTLESS UNIT, OUTDOOR UNIT	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3030224	D3030224 - SPLIT SYSTEM HEAT PUMP , OUTDOOR UNIT	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3040	D3040 - DISTRIBUTION SYSTEMS	SYSTEM	●	Yes	●	●	●	●
D3040132	D3040132 - VAV TERMINAL	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3040220	D3040220 - FAN SYSTEM, CENTRIFUGAL IN-LINE	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3040240	D3040240 - FAN SYSTEM, ROOF EXHAUST	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3040330	D3040330 - CIRCULATING PUMP, END SUCTION	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3040901	D3040901 - DEHUMIDIFIER	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3040904	D3040904 - SPLIT DUCTLESS SYSTEM, INDOOR UNIT	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3040905	D3040905 - SPLIT SYSTEM HEAT PUMP, INDOOR UNIT	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3050	D3050 - TERMINAL & PACKAGE UNITS	SYSTEM	●	Yes	●	●	●	●
D3050120	D3050120 - UNIT HEATERS, GAS	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3050130	D3050130 - UNIT HEATERS, HYDRONIC	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3050178	D3050178 - ROOFTOP AIR CONDITIONER, HOT WATER HEAT	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3050905	D3050905 - HYDRONIC HEATING - FIN TUBE	SUBSYSTEM	LF	Yes	MECHANICAL	300	A	A+
D3060	D3060 - CONTROLS & INSTRUMENTATION	SYSTEM	●	Yes	●	●	●	●
D3060901	D3060901 - HVAC CONTROLS, ELECTRIC, DIGITAL	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D3060905	D3060905 - DIRECT DIGITAL CONTROL (DDC) SYSTEM	SUBSYSTEM	EA	Yes	MECHANICAL	300	A	A+
D40	D40 - FIRE PROTECTION	MASTERSYSTEM	●	Yes	●	●	●	●
D4010	D4010 - SPRINKLERS	SYSTEM	●	Yes	●	●	●	●
D4010310	D4010310 - DRY PIPE SYSTEMS	SUBSYSTEM	SF	Yes	FIRE	300	A	A+
D4010410	D4010410 - WET PIPE SYSTEMS	SUBSYSTEM	SF	Yes	FIRE	300	A	A+
D4010905	D4010905 - FIRE PUMP, ELECTRIC MOTOR DRIVEN	SUBSYSTEM	EA	Yes	FIRE	300	A	A+
D4010907	D4010907 - JOCKEY PUMP	SUBSYSTEM	EA	Yes	FIRE	300	A	A+
D4020	D4020 - STANDPIPES	SYSTEM	●	Yes	●	●	●	●
D4020310	D4020310 - RISER	SUBSYSTEM	FLOOR	Yes	FIRE	300	A	A+
D4030	D4030 - FIRE PROTECTION SPECIALTIES	SYSTEM	●	Yes	●	●	●	●
D4090	D4090 - OTHER FIRE PROTECTION SYSTEMS	SYSTEM	●	Yes	●	●	●	●
D4090903	D4090903 - BACKFLOW PREVENTER	SUBSYSTEM	EA	Yes	FIRE	300	A	A+
D4090904	D4090904 - FIRE PUMPS	SUBSYSTEM	EA	Yes	FIRE	300	A	A+
D4090920	D4090920 - CLEAN AGENT EXTINGUISHING SYSTEM	SUBSYSTEM	SF	Yes	FIRE	300	A	A+
D50	D50 - ELECTRICAL	MASTERSYSTEM	●	Yes	●	●	●	●
D5010	D5010 - ELECTRICAL SERVICE & DISTRIBUTION	SYSTEM	●	Yes	●	●	●	●
D5010120	D5010120 - ELECTRICAL SERVICE	SUBSYSTEM	EA	Yes	ELECTRICAL	200	A	A+
D5010901	D5010901 - TRANSFER SWITCH	SUBSYSTEM	EA	Yes	ELECTRICAL	200	A	A+
D5010902	D5010902 - TRANSFORMER	SUBSYSTEM	EA	Yes	ELECTRICAL	200	A	A+
D5010906	D5010906 - PANELBOARDS	SUBSYSTEM	EA	Yes	ELECTRICAL	200	A	A+
D5020	D5020 - LIGHTING & BRANCH WIRING	SYSTEM	●	Yes	●	●	●	●

D5020120	D5020120 - ELECTRICAL DISTRIBUTION	SUBSYSTEM	SF	Yes	ELECTRICAL	200	A	A+
D5020901	D5020901 - EXIT LIGHTING	SUBSYSTEM	EA	Yes	ELECTRICAL	300	A	A+
D5020903	D5020903 - EXTERIOR LIGHTING	SUBSYSTEM	EA	Yes	ELECTRICAL	300	A	A+
D5030	D5030 - COMMUNICATION AND SECURITY	SYSTEM	•	Yes	•	•	•	•
D5030910	D5030910 - COMMUNICATION/ALARM SYSTEMS	SUBSYSTEM	EA	Yes	ELECTRICAL	200	A	A+
D5030911	D5030911 - FIRE ALARM CONTROL PANEL & ALARM SYSTEM	SUBSYSTEM	EA	Yes	ELECTRICAL	200	A	A+
D5090	D5090 - OTHER ELECTRICAL SYSTEMS	SYSTEM	•	Yes	•	•	•	•
D5090210	D5090210 - GENERATORS	SUBSYSTEM	EA	Yes	ELECTRICAL	300	A	A+
D5090901	D5090901 - EMERGENCY LIGHTING	SUBSYSTEM	EA	Yes	ELECTRICAL	300	A	A+
D5090902	D5090902 - LIGHTNING PROTECTION (ARRESTERS)	SUBSYSTEM	EA	Yes	ELECTRICAL	200	A	A+
D5090903	D5090903 - GROUNDING SYSTEM	SUBSYSTEM	EA	Yes	ELECTRICAL	200	A	A+
D5090904	D5090904 - UNINTERRUPTIBLE POWER SUPPLY	SUBSYSTEM	EA	Yes	ELECTRICAL	300	A	A+
E10	E10 - EQUIPMENT	MASTERSYSTEM	•	Yes	•	•	•	•
F1010	F1010 - COMMERCIAL EQUIPMENT	SYSTEM	•	Yes	•	•	•	•
E1010910	E1010910 - REFRIGERATOR/FREEZER WALK-IN BOX	SUBSYSTEM	EA	Yes	ARCHITECTURAL	200	A	A+
F10	F10 - SPECIAL CONSTRUCTION	MASTERSYSTEM	•	Yes	•	•	•	•
F1010	F1010 - SPECIAL STRUCTURES	SYSTEM	•	Yes	•	•	•	•
F101001	F101001 - PRE-ENGINEERED STRUCTURES	SUBSYSTEM	SF	Yes	ARCHITECTURAL	300	A	A+
F20	F20 - SELECTIVE BUILDING DEMOLITION	MASTERSYSTEM	•	Yes	•	•	•	•
F2010	F2010 - BUILDING ELEMENTS DEMOLITION	SYSTEM	•	Yes	•	•	•	•
F201007	F201007 - ELECTRICAL SYSTEMS	SUBSYSTEM	LS	Yes	ELECTRICAL	200	C	C+
G20	G20 - SITE IMPROVEMENTS	MASTERSYSTEM	•	Yes	•	•	•	•
G2010	G2010 - PAVEMENTS	SYSTEM	•	Yes	•	•	•	•
G201002.01	G201002.01 - CURBS AND GUTTERS	SUBSYSTEM	CY	Yes	CIVIL	300	A	A+
G201002.02	G201002.02 - DRAINS	SUBSYSTEM	EA	Yes	CIVIL	300	A	A+
G201003.01	G201003.01 - FLEXIBLE ASPHALT PAVEMENTS	SUBSYSTEM	SF	Yes	CIVIL	300	A	A+
G201003.02	G201003.02 - RIGID CONCRETE PAVEMENTS	SUBSYSTEM	SF	Yes	CIVIL	300	A	A+
G201004	G201004 - MARKINGS AND SIGNAGE	SUBSYSTEM	EA	Yes	CIVIL	300	A	A+
G201005.04	G201005.04 - VEHICLE TRAFFIC ARM	SUBSYSTEM	EA	Yes	CIVIL	300	A	A+
G2020	G2020 - A PARKING LOT /PARKING AREA PAVEMENT	SYSTEM	•	Yes	•	•	•	•
G202001	G202001 - PARKING LOT BASES AND SUBBASES	SUBSYSTEM	EA	Yes	CIVIL	300	A	A+
G202005.02	G202005.02 - WHEEL STOPS	SUBSYSTEM	EA	Yes	CIVIL	300	A	A+
G2030	G2030 - PEDESTRIAN PAVING	SYSTEM	•	Yes	•	•	•	•
G203003.02	G203003.02 - CONCRETE PEDESTRIAN PAVING	SUBSYSTEM	SF	Yes	CIVIL	300	A	A+
G2040	G2040 - SITE IMPROVEMENTS & AMMENITIES	SYSTEM	•	Yes	•	•	•	•
G204001.01	G204001.01 - FENCES AND GATES	SUBSYSTEM	LF	Yes	CIVIL	300	A	A+
G204001.02	G204001.02 - FENCES - CHAIN LINK	SUBSYSTEM	LF	Yes	CIVIL	300	A	A+
G204001.03	G204001.03 - FENCES - MISCELLANEOUS METAL	SUBSYSTEM	LF	Yes	CIVIL	300	A	A+
G204002	G204002 - RETAINING WALLS	SUBSYSTEM	LF	Yes	CIVIL	300	A	A+
G204005	G204005 - SIGNAGE	SUBSYSTEM	EA	Yes	CIVIL	200	B	B+
G204009	G204009 - FLAG POLES	SUBSYSTEM	EA	Yes	CIVIL	300	A	A+
G204099.01	G204099.01 - SITE FURNISHINGS	SUBSYSTEM	EA	Yes	CIVIL	300	A	A+
G204099.02	G204099.02 - SITE SEATING	SUBSYSTEM	EA	Yes	CIVIL	300	A	A+
G204099.03	G204099.03 - HANDRAIL - PIPE RAILINGS	SUBSYSTEM	LF	Yes	CIVIL	300	A	A+
G204099.09	G204099.09 - OUTDOOR COVERING	SUBSYSTEM	SF	Yes	CIVIL	300	A	A+
G2050	G2050 - LANDSCAPING	SYSTEM	•	Yes	•	•	•	•
G205004	G205004 - LAWNS AND GRASSES	SUBSYSTEM	SF	Yes	LANDSCAPE	200	B	B+
G205005	G205005 - EXTERIOR PLANTS	SUBSYSTEM	EA	Yes	LANDSCAPE	200	B	B+
G205006	G205006 - PLANTERS	SUBSYSTEM	EA	Yes	LANDSCAPE	200	B	B+
G205099	G205099 - LANDSCAPING	SUBSYSTEM	SF	Yes	LANDSCAPE	200	B	B+
G2060	G2060 - A ROAD/ STREET PAVEMENT	SYSTEM	•	Yes	•	•	•	•
G206001	G206001 - ROAD BASES AND SUBBASES	SUBSYSTEM	EA	Yes	CIVIL	300	A	A+
K10	K10 - Potable Water Utilities	MASTERSYSTEM	•	Yes	•	•	•	•
K1020	K1020 - Distribution	SYSTEM	•	Yes	•	•	•	•
K1020100	K1020100 - Service Areas	SUBSYSTEM	EA	Yes	CIVIL	300	A	A+
M10	M10 - Sanitary Sewer Utilities	MASTERSYSTEM	•	Yes	•	•	•	•
M1020	M1020 - Distribution	SYSTEM	•	Yes	•	•	•	•
M1020120	M1020120 - Pump Stations	SUBSYSTEM	EA	Yes	CIVIL,	300	A	A+
M40	M40 - Storm Water Utilities	MASTERSYSTEM	•	Yes	•	•	•	•
M4020	M4020 - Distribution	SYSTEM	•	Yes	•	•	•	•
M4020100	M4020100 - Service Area	SUBSYSTEM	EA	Yes	CIVIL,	300	A	A+
M4020110	M4020110 - Storage	SUBSYSTEM	EA	Yes	CIVIL,	300	A	A+
W10	W10 - CATHODIC PROTECTION SYSTEM	MASTERSYSTEM	•	Yes	•	•	•	•
W1020	W1020 - GALVANIC CP	SYSTEM	•	Yes	•	•	•	•
W102010	W102010 - ANODES	SUBSYSTEM	EA	Yes	CP	200	A	A+
W102020	W102020 - TEST STATIONS/BOXES	SUBSYSTEM	EA	Yes	CP	200	A	A+

SECTION 01 91 00.15 20

TOTAL BUILDING COMMISSIONING
02/21

PART 1 GENERAL

Total Building Commissioning (TBCx) is a systematic, quality-focused process for enhancing the delivery of a project that focuses on verifying and documenting that all of the commissioned systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the project requirements. The purpose is to reduce the cost and performance risks associated with delivering facilities projects, and to increase value to owners, occupants, and users.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 202 (2018) Commissioning Process for Buildings
and Systems

ASSOCIATED AIR BALANCE COUNCIL (AABC)

ACG Commissioning Guideline (2005) Commissioning Guideline

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Commissioning Standard (2009) Procedural Standards for Whole
Building Systems Commissioning of New
Construction; 3rd Edition

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

ANSI/SMACNA 014 (2013) HVAC Systems Commissioning Manual,
2nd Edition

U.S. ARMY CORPS OF ENGINEERS (USACE)

ER 25-345-1 (2019) Systems Manual

1.2 DEFINITIONS

Commissioning Process (Cx) - a quality-focused process for enhancing the delivery of a project. Refer to ASHRAE 202 for a comprehensive description of the commissioning process.

Commissioning Provider (CxA) - The entity who leads, plans, and coordinates the Commissioning Team. The terms Commissioning Provider, Commissioning Firm, Lead Commissioning Specialist, Commissioning Specialist, and Commissioning Authority (CA or CxA) when used by sustainable Third Party Certification (TPC) programs, are interchangeable.

1.3 COMMUNICATION WITH THE GOVERNMENT

The Lead Commissioning Specialist (CxA) must submit all plans, schedules, reports, and documentation directly to the Contracting Officer's Representative concurrent with submission to the QC Manager.

The Lead Commissioning Specialist must have direct communication with the Contracting Officer's Representative regarding all elements of the commissioning process; however, the Government has no direct contract authority with the Lead Commissioning Specialist.

The QC Manager must communicate directly with the CxA and Contracting Officer's Representative regarding all elements of the commissioning process; however, the CxA has no direct contract authority.

1.4 SYSTEMS TO BE COMMISSIONED

Coordinate commissioning and quality control activities for the following systems, equipment, and associated controls. System-specific requirements are located in the associated specification Sections. Commission the following systems, equipment, and associated controls in accordance with this section and the inspection, testing, and quality control requirements of their respective sections:

Heating, ventilating, air-conditioning, and refrigeration systems (mechanical and passive) and associated controls

Air-curtain systems

Lighting systems: automatic and manual daylighting controls, occupancy sensing devices, automatic shut-off controls, time switching, and other lighting control devices, and dimming systems

Domestic hot-water systems and controls

Energy and building management and demand-control systems

Building Envelope: air tightness for the entire building envelope (systems, components, and assemblies).

1.5 COMMISSIONING TEAM

The Commissioning team will include, but is not limited to the following team members.

Ensure all Design and Construction Activities for systems to be commissioned are coordinated with the appropriate commissioning team members.

- a. Lead Commissioning Specialist (CxA)
- b. Quality Control Manager (QCM)
- c. Sub-Contractor Representatives for each trade responsible for construction/installation of systems to be commissioned
- d. Construction Manager (CM)

- e. Designer of Record (DOR)
- f. Technical Commissioning Specialists for each system to be commissioned
- g. TAB Representative
- h. Equipment manufacturer representatives
- i. Contracting Officer
- j. Government Acceptance Testing Representatives
- k. Installation Maintenance Representative
- l. Facility End User

1.6 PROJECT SCHEDULE

Include the following tasks in the project schedule required by Section 01 32 17.00 20 COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS). Ensure sufficient time is scheduled to complete each item. The order of items listed below is not intended to imply a specified sequence:

- a. Submission and approval of the Commissioning Firm Qualifications
- b. Submission and approval of the Design Phase Commissioning Plan
- c. Submission and approval of the Design Review Report
- d. Submission and approval of the Final Construction Phase Commissioning Plans
- e. Commissioning Kickoff Coordination Meeting
- f. Regular Commissioning Coordination Meetings
- g. Installation of permanent utilities (gas, water, electric)
- h. Manufacturer's Equipment Start-Up for each of the systems to be commissioned
- i. Submission and approval of the Completed Pre-Functional Checklists
- j. Submission and approval of Certificate of Readiness for each system to be commissioned
- k. Functional Performance Testing for each system to be commissioned
- l. Post-test deficiency correction for each system to be commissioned
- m. Re-Testing
- n. Training for each of the systems to be commissioned
- o. Submission and approval of the Initial and Final Commissioning Reports
- p. Seasonal Testing
- q. Warranty Phase Site Visit

r. Updated Commissioning report

1.7 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05 Design Data

Design Phase Commissioning Plan; G

SD-06 Test Reports

Design Review Report; G

Final Construction Phase Commissioning Plan; G

Issues Log; G

Completed Pre-Functional Checklists; G

SD-07 Certificates

Commissioning Firm; G

Certificate Of Readiness; G

SD-11 Closeout Submittals

Final Commissioning Report; G

Updated Final Commissioning Report; G

1.8 COMMISSIONING FIRM

The Government hires the services of a Commissioning Firm and all Commissioning Specialists required to perform work for this project. The Commissioning Firm must be a first-tier subcontractor that is financially and corporately independent from contractor and all other subcontractors and the Designer of Record.

- a. Submit the Commissioning Firm's and Commissioning Specialists' qualifications, including the name of the firm and each CxA and each certification, no later than 30 calendar days after Notice to Proceed.
- b. If, for any reason, a specialist loses a certification during this period, immediately notify the Contracting Officer and submit another Commissioning Specialist for approval. Validate all work performed for this project by the CxA who lost a certification by an approved successor.

1.8.1 Commissioning Specialists (CxA)

Assign Lead Commissioning Specialist and other appropriate Commissioning Specialists for the systems to be commissioned.

1.8.1.1 Lead Commissioning Specialist (CxA)

Lead Commissioning Specialist (CxA) coordinates all aspects of the commissioning process. Duties include leading and overseeing the commissioning work, and acting as the primary point of contact for the commissioning work. CxA may serve as a systems Specialist if all requirements for both designations are met. CxA must have a minimum of five years of commissioning experience, including two projects of similar size and complexity to this project.

CxA must be certified in one of the following:

NEBB qualified Systems Commissioning Administrator (SCA)

ACG Certified Commissioning Authority (CxA)

ICB/TABB Certified Commissioning Supervisor

BCA Certified Commissioning Professional (CCP)

AEE Certified Building Commissioning Professional (CBCP)

University of Wisconsin-Madison Qualified Commissioning Process Provider (QCxP)

ASHRAE Building Commissioning Professional (BCxP).

1.8.1.2 Commissioning Specialists

Commissioning Specialists with the following qualifications must perform the technical work associated with each system to be commissioned:

- a. Mechanical Commissioning Specialist: The technical work associated with mechanical systems to be commissioned must be performed by a Commissioning Specialist certified by NEBB, ACG, ICB/TABB, AEE, University of Wisconsin-Madison, ASHRAE, or BCA in the commissioning of HVAC systems with five years of experience in the commissioning of HVAC systems.
- b. Electrical Commissioning Specialist: The technical work associated with electrical systems to be commissioned must be performed by an engineering technician with five years of experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.
- c. Building Envelope Commissioning Specialist: The technical work associated with the Building Envelope system must be performed by a registered architect with five years of building envelope design or construction experience or a professional with training and certification as an Air Barrier Installer from the Air Barrier Association of America (ABAA) or other third party air barrier association..

1.8.2 Commissioning Standard

Comply with the requirements of the commissioning standard under which the Commissioning Firm and Specialists qualifications are approved. When the firm and specialists are certified by BCA, AEE, ASHRAE, or the University of Wisconsin-Madison, comply with the requirements of one of these

acceptable standards: ACG Commissioning Guideline, NEBB Commissioning Standard, ANSI/SMACNA 014, or ASHRAE 202. Comply with applicable NETA testing standards for electrical systems.

- a. Implement all recommendations and suggested practices contained in the Commissioning Standard and electrical test standards.
- b. Use the Commissioning Standard for all aspects of Commissioning, including calibration of instruments.
- c. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the Commissioning Standard, adhere to the manufacturer calibration recommendations.
- d. All quality assurance provisions of the Commissioning Standard such as performance guarantees are part of this contract.
- e. The Commissioning Specialists must develop commissioning procedures for any systems or system components not covered in the Commissioning Standard.
- f. Use any new requirements, recommendations, and procedures published or adopted by the body responsible for the Commissioning Standard at the time of project award.
- g. If there is a conflict between the requirements of the contract documents and the commissioning standard used, the contract documents take precedent.

1.9 GOVERNMENT COMMISSIONING PROVIDER

The Commissioning Provider (CxA) is employed by Government under separate contract. Incorporate key milestones of the Commissioning process into the Project Schedule identified in this Section.

1.10 SUSTAINABILITY THIRD PARTY CERTIFICATION (TPC)

The Commissioning Specialist must perform all commissioning activities, coordination, and submittals required by the sustainability Third Party Certification (TPC) program applied to this project, in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

CxA must provide documentation or perform commissioning activities, coordination and submittals as required by Leadership in Energy and Environmental Design (LEED) Fundamental Commissioning and Verification and Enhanced Commissioning Option 1: Path 1 Enhanced Commissioning and Envelope Commissioning.

1.11 ISSUES LOG

The Commissioning Specialist develops and maintain an Issues Log for the systems to be commissioned. The issues log documents and tracks resolution of deficiencies identified during submittal reviews, inspection, and testing. At any point during construction, any commissioning team member finding deficiencies may communicate those deficiencies in writing to the Commissioning Specialist for inclusion into the Issues Log. For each issue, the Issues Log includes, but is not limited to, a unique reference number, description of the issue with contract requirement referenced, location of or equipment name/tags

exhibiting the issue, the initials of the individual's name whom reported the issue, the date of first observation, the proposed resolution of the issue and date proposed, the date of any subsequent observations with applicable additional information, and the date of implementation of the final resolution of the issue as confirmed by the Commissioning Specialist and Contracting Officer. Issues must not be deleted from the issues log.

CxA must submit the Issues Log monthly and within three working days from changes to the Issue Log. The CxA is responsible for distributing the Issues Log to the Commissioning Team. CQC System Manager must track construction deficiencies identified in the Issues Log using QCS in accordance with Section 01 45 00.00 20 QUALITY CONTROL. The QC manager is responsible for notifying the CxC and Contracting Officer of outstanding deficiencies and tracking them to resolution in accordance with Section 01 45 00.05 20 DESIGN AND CONSTRUCTION QUALITY CONTROL 01 45 00.00 20 QUALITY CONTROL, "Quality Control Plan".

1.12 CERTIFICATE OF READINESS

Prior to scheduling Functional Performance Tests, the Quality Control Manager must issue a Certificate of Readiness for each system, certifying that pre-functional checks have been completed, open issues have been resolved, and the system is ready for Functional Performance Testing. The Certificate of Readiness must include, for each system to be commissioned, equipment and system start-up reports; Performance Verification Test Reports; the Air Leakage Test Reports and Diagnostic Test Reports; completed Pre-Functional Checklists; Testing, Adjusting, and Balancing (TAB) Report; Issues Log; and HVAC Controls Start-Up Reports to the extent applicable to the system. Sign and date the Certificate of Readiness, and include signatures and dates from the CxA; the Quality Control Representative; the Mechanical, Electrical, Controls, and TAB subcontractor representatives.

Submit the Certificate of Readiness for each system 14 calendar days prior to Functional Performance Tests of that system. Do not schedule Functional Performance Tests for a system until the Certificate of Readiness is approved by the Government.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 DESIGN PHASE COMMISSIONING PLAN

Submit the Design Phase Commissioning Plan no later than 14 calendar days after the Design Commissioning Coordination Meeting. Outline the commissioning process, commissioning team members and responsibilities, lines of communication, and documentation requirements for the design phase of the project in the Design Phase Commissioning Plan. Identify the Commissioning Standard chosen for the project.

Provide a list of team members for systems to be commissioned with contact information, a list of tests as required by Section 01 33 00 SUBMITTAL PROCEDURES, and project schedule as required by Section 01 32 17.00 20 COST-LOADED NETWORK ANALYSIS SCHEDULE for inclusion in the Design Phase Commissioning Plan no later than 14 calendar days after the Design Commissioning Coordination Meeting.

3.2 DESIGN REVIEW

The CxA and other Commissioning Specialists must review design documents. The design review must include verifying the Design Plans and Specifications for the systems to be commissioned are prepared in accordance with the contract documents.

Provide a Design Review Report identifying discrepancies or deficiencies that would prevent the systems to be commissioned from operating or performing in accordance with the design requirements or being safely maintained. Report must include individual list of each deficiency and corresponding corrective action necessary for proper system performance. The Contracting Officer, the CxA, and the Designers of Record for the associated systems must meet, discuss, and resolve any outstanding items contained in the report no later than 14 calendar days after submission of the report. The CxA must verify that their review comments have been adequately addressed in subsequent design submittals.

The CxA is responsible for reviewing the design and preparing a Design Review Report identifying discrepancies or deficiencies that would prevent the systems to be commissioned from operating or performing in accordance with the design requirements or being safely maintained.

The Contracting Officer, the CxA, and the Designers of Record for the associated systems must meet, discuss, and resolve any outstanding items contained in the report no later than 14 calendar days after submission of the report. The CxA will verify that their review comments have been adequately addressed in subsequent design submittals.

3.3 CONSTRUCTION SUBMITTAL REVIEWS

Coordinate construction submittal document reviews for commissioned systems and assemblies with the CxA. The commissioning submittal review does not replace the designer of record (DoR) or Government submittal review.

The CxA must identify construction submittals to be provided by the contractor for the commissioned systems. The CxA must evaluate construction submittals for compliance with the contract documents. The CxA is responsible for identifying construction submittals to be provided by the contractor for the commissioned systems. The CxA is responsible for evaluating construction submittals for compliance with the contract documents. The DoR must consider the CxA's comments and provide direction to the contractor as necessary. Provide a copy of final DoR submittal reviews with comment responses to the CxA. Include a copy of the submittal document review transmittal and response in the Commissioning Report.

3.4 COMMISSIONING KICKOFF MEETING

Conduct a Commissioning Kickoff Meeting, led by the CxA, after approval of the Commissioning Firm and Commissioning Specialists, and no later than 60 days following construction notice to proceed. Discuss The CxA is responsible for conducting a Commissioning Kickoff Meeting no later than 60 days following construction notice to proceed to discuss the commissioning process including contract requirements, lines of communication, roles and responsibilities, schedules, documentation requirements, inspection and test procedures, and logistics as specified

in this section.

The Quality Control team, Designer of Record, and the Government must attend this meeting. Invite the User and a Public Works Division Representative to attend this meeting.

3.5 REGULAR COMMISSIONING COORDINATION MEETINGS

CxA must conduct monthly commissioning coordination meetings when installation of commissioned systems begins. Provide status of commissioned systems, open issues log items, outstanding submittals, and upcoming commissioning activities. Conduct bi-weekly commissioning coordination meetings within 30 days of the scheduled date for functional performance testing.

Participate in monthly commissioning coordination meetings led by the CxA when installation of commissioned systems begins. Provide status of commissioned systems, open issues log items, outstanding submittals, and upcoming commissioning activities. Participate in bi-weekly commissioning coordination meetings within 30 days of the scheduled date for functional performance testing.

3.6 CONSTRUCTION PHASE COMMISSIONING PLANS

The Interim Construction Phase Commissioning Plan identifies the commissioning and testing standards and outline the overall commissioning process, the commissioning schedule, the commissioning team members and responsibilities, lines of communication, documentation requirements for the construction phase of the project. Provide a list of team members for systems to be commissioned with contact information, a list of tests as required by Section 01 33 00 SUBMITTAL PROCEDURES, and project schedule as required by Section 01 32 17.00 20 COST-LOADED NETWORK ANALYSIS SCHEDULE for inclusion in the Final Construction Phase Commissioning Plan no later than 14 calendar days after the Commissioning Coordination Meeting.

The Final Construction Phase Commissioning Plan includes the information provided in the Pre-Functional Checklists and Functional Performance Test Checklists for each building, for each system required to be commissioned, and for each component for inclusion in the Final Construction Phase Commissioning Plan. Submit the Final Construction Phase Commissioning Plan no later than 90 calendar days prior to the start of Pre-Functional Checks. Provide updates to the list of team members for systems to be commissioned with contact information, a list of tests as required by Section 01 33 00 SUBMITTAL PROCEDURES, and project schedule as required by Section 01 32 17.00 20 COST-LOADED NETWORK ANALYSIS SCHEDULE for inclusion in the Final Construction Phase Commissioning Plan within 14 calendar days of a written request from the CxA.

3.6.1 Pre-Functional Checklists

The Pre-Functional Checklists must include items for physical inspection or testing that demonstrate that installation and start-up of equipment and systems is complete. Refer to paragraph PRE-FUNCTIONAL CHECKS. Pre-functional checklists must be tailored to verify the specific installation requirements and details of the construction documents and manufacturer's instructions.

Use the Pre-Functional Checklists prepared by the CxA for physical inspection or testing to demonstrate that installation and start-up of

equipment and systems is complete. Refer to paragraph PRE-FUNCTIONAL CHECKS.

3.6.2 Functional Performance Test Checklists

Functional Performance Test Checklists must include procedures that explain, step-by-step, the actions and expected results that will demonstrate that the system performs in accordance with the contract. Refer to paragraph FUNCTIONAL PERFORMANCE AND INTEGRATED SYSTEMS TESTS. Include the following sections and details appropriate to the systems being tested in the Functional Performance Test Checklists:

- a. Notable system features including information about controls to facilitate understanding of system operation
- b. Conclusions and recommendations. Conclusions must clearly indicate if system does or does not perform in accordance with contract requirements. Recommendation must clearly indicate that the system should or should not be accepted by the Government.
- c. Test conditions including date, beginning and ending time, and beginning and ending outdoor air conditions
- d. Attendees
- e. Identification of the equipment involved in the test
- f. Control system feature identification
- g. Point-to-point observations including demonstrating system flow meters and sensors have been calibrated and are correctly displayed on the Operator work station
- h. Actuator operation observations demonstrating actuator responses to commands from the control system
- i. As-found condition of the system operation
- j. List of test items with step numbers along with the corresponding feature or control operation, intended test procedure, expected system response, and pass/fail indication.
- k. Space for comments for each test item.

Use the Functional Performance Test Checklists prepared by the CxA that list, step-by-step, the actions and expected results that will demonstrate that the system performs in accordance with the contract. Refer to paragraph FUNCTIONAL PERFORMANCE AND INTEGRATED SYSTEMS TESTS.

3.7 PRE-FUNCTIONAL CHECKS

Complete one Pre-Functional Checklist for each individual item of equipment or system for each system required to be commissioned including, but not limited to, ductwork, piping, equipment, fixtures (lighting and plumbing), and controls. Indicate commissioning team member inspection and acceptance of each Pre-Functional Checklist item by initials. Acceptance of each Pre-Functional Checklist item by each team member indicates that item conforms to the contract documents and accepted design in their area of responsibility. Commissioning Specialist acceptance of

each Pre-Functional Checklist item indicates that each item has been installed correctly and in accordance with contract documents and the Owner's Project Requirements (OPR). Submit the initialed and Completed Pre-Functional Checklists no later than 7 calendar days after completion of inspection of all checklist items for each system. Include manufacturer start-up checklists associated with equipment with the submission of the Pre-Functional Checklists.

3.8 FUNCTIONAL PERFORMANCE TESTS

Demonstrate that all system components have been installed, that each control device and item of equipment operates, and that the systems operate and perform, including interactive operation between systems, in accordance with contract documents and the OPR. Provide all materials, services, and labor required to perform the Pre-Functional Checks and Functional Performance Tests.

Commissioning Specialist's duties include leading and documenting all tests for the systems to be commissioned with appropriate sub-contractors performing the Tests. The representatives listed in the paragraph Commissioning Team must attend the tests.

3.8.1 Test Scheduling and Coordination

Conduct Initial Functional Performance Tests as soon as all contract work is completed, regardless of the season. Develop and implement means of artificial loading to demonstrate, to a reasonable level of confidence, the ability of the HVAC systems to handle peak seasonal loads. Schedule Functional Performance Tests for each system only after the Certificate of Readiness has been approved by the Government for the system. Correct all deficiencies identified through any prior review, inspection, or test activity before the start of Functional Performance Tests.

3.8.2 Testing Procedures

Functional performance testing is conducted by simulating conditions at control devices to initiate a control system response. Over-writing control input values through the control system is not acceptable unless approved by the Contracting Officer. Do not simulate conditions when damage to the system or building may result.

Follow the Functional Performance Test from the approved Final Construction Phase Commissioning Plan. Perform Functional Performance Tests for each item of equipment and each system required to be commissioned. Verify all sensor calibrations, control responses, safeties, interlocks, operating modes, sequences of operation, capacities, lighting levels, and all other performance requirements comply with contract, regardless of the specific items listed within the checklists provided. In general, testing must progress from equipment or components to subsystems to systems to interlocks and connections between systems. Commissioning Specialists are responsible for determining the order of components and systems to be tested. Indicate acceptance of each item of equipment and systems tested by signature of each commissioning team member for each test. The Quality Control Representative, Commissioning Specialists, and Contracting Officer's Representative, if present, must indicate acceptance after the equipment and systems are free of deficiencies.

3.8.3 Sample Strategy

Perform Functional Performance Tests for all systems and equipment to be commissioned using the sample strategy identified herein. Complete a Functional Performance Test Checklist for each item of equipment or system to be tested. For sample sizes less than 100 percent for similar equipment, the Contracting Officer's Representative reserves the right to select the specific equipment or system to be tested during testing.

Test all central plant equipment, primary air handling units, and process cooling or heating equipment. Test all system-level equipment serving multiple zones. Twenty percent sample testing is allowed for large groups of identical equipment with identical controllers serving single zones such as air terminal units, fan coil units, unitary equipment, lighting zones, and plumbing fixtures.

3.8.3.1 100 Percent Sample Procedures

Systems or equipment for which 100 percent sample size are tested fail if one or more of the test procedures results in discovery of a deficiency and the deficiency cannot be resolved within 5 minutes during the test.

Re-test to the extent necessary to confirm that the deficiencies have been corrected without negatively impacting the performance of the rest of the system.

3.8.3.2 Less than 100 Percent Sample Procedures

Randomly test each sample group of identical equipment. Sample size must be at least three units. If 10 percent of the units in the first sample fail the functional performance tests, test a second sample group, the same size as the first sample group. The second sample must not include any units from the first sample group.

If 10 percent of the units in the second sample fail, test all remaining units. If at any point frequent failures occur, and testing becomes more troubleshooting than verification, the CxA may stop the testing and require the contractor to perform and document a checkout of the remaining units prior to continuing functional testing.

3.8.4 Aborted Tests and Re-Testing

Abort any test if any deficiency prevents successful completion of the test or if any required commissioning team member is not present for the test. Re-test after all deficiencies identified during the original test have been corrected. Contracting Officer may withhold payment equivalent to lost time, re-testing, and aborted tests. These costs may include salary, travel costs, and per diem for Government commissioning team members.

3.9 TRAINING PLAN

CxA must review the training plan for training associated with the equipment and systems to be commissioned, checking that each plan has the trainer name, trainer contract information, training schedule and location. Submit review at least 30 days prior to the first training event. Incorporate CxA review comments prior to submitting training plan in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT

INFORMATION (eOMSI). Update and resubmit the training plan based on any corrective action taken.

Document training attendance using training attendance rosters and submit completed attendance rosters no later than 7 calendar days following the completion of training for each system to be commissioned.

3.9.1 Systems Manual

The Systems Manual includes the Basis of Design, system single line diagrams, as-built sequences of operation and controls drawings, as-built control setpoints, recommended schedule for sensor and actuator calibration, recommended schedule of maintenance when not in the O&M manuals, recommended re-testing schedule with proposed testing forms, and full equipment warranty information for all commissioned systems. Incorporate CxA review comments prior to submitting Systems Manual in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Update and resubmit the system manual information based on any corrective action taken during the warranty period.

Prepare and submit a Systems Manual, including a signed certification or letter from the Commissioning Specialists and the CxA stating that the Systems Manual is complete, clear, and accurate. The Systems Manual, for all commissioned systems, must conform to Appendix A SYSTEMS MANUAL ORGANIZATION AND CONTENT to ER 25-345-1, available at the USACE Publications website at the following location: <https://www.publications.usace.army.mil/USACE-Publications/Engineer-Regulations/>. Submit Systems Manual no later than 30 calendar days following completion of Functional Performance Tests. Update and resubmit the Systems Manual based on any corrective action taken during the warranty period.

Provide updates to Commissioning Provider for inclusion in the Systems Manual to identify any corrective action taken during the warranty period.

Ensure Systems Manual is coordinated with the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA and Quality Control requirements.

3.10 COMMISSIONING REPORT

Submit a Final Commissioning Report upon completion of training and trend log reviews. Include the following information in the Final Commissioning Report:

- a. An executive summary describing the overall commissioning process, the results of the commissioning process, outstanding deficiencies and recommended resolutions, and seasonal testing that must be scheduled for a later date. Indicate, in the executive summary, whether the systems meet the requirements of the contract documents and the OPR.
- b. A list of deficiencies discovered during the commissioning process and the corrective actions taken in the report.
- c. Completed Building Envelope Inspection Checklists, Pre-Functional Checklists, Functional Performance Test Checklists, Integrated Systems Test Checklists, the Final Construction Phase Commissioning Plan, the Issues Log, Training Attendance Rosters, the Design Review Reports, Submittal Review Report, and the approved TAB Report.

The Commissioning Specialist is responsible for preparing a Commissioning Report following commissioning team acceptance of all Functional Performance Tests and Integrated Systems Tests, with the exception of Seasonal Tests. Provide information including, but not limited to, outstanding deficiencies and recommended resolutions, seasonal testing that must be scheduled for a later date, Completed Building Envelope Inspection Checklists, Pre-Functional Checklists, Training Attendance Rosters, PVT Report, and the approved TAB Report within 14 days of request.

3.11 WARRANTY PHASE SITE VISIT

The Lead Commissioning Specialist must visit the building site concurrent with the 9 month warranty inspection to inspect building system equipment and review building operation with the building operating/maintenance staff, and identify any deficiency of the building systems to operate in accordance with the contract documents and the OPR. The Commissioning Specialist must notify the Contracting Officer of any identified deficiencies and the proposed corrective action. Submit Updated Final Commissioning Report and Systems Manuals, documenting the results of the warranty phase inspection. Include other warranty phase activities, such as Seasonal testing results.

Notify the Lead Commissioning Specialist at least 28 calendar days prior to visiting building site for the 9 month warranty inspection. Provide updates to any documentation included in the Commissioning Report based on the results of the warranty phase inspection. Provide all warranty phase documentation, such as Seasonal testing results to the Commissioning Specialist.

-- End of Section --

SECTION 02 41 00

DEMOLITION
05/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline K (2009) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145 (1991; R 2012) Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

AASHTO T 180 (2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.6 (2006) Safety & Health Program Requirements for Demolition Operations - American National Standard for Construction and Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety and Health Requirements Manual

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25 (Jun 2000; Reaffirmed Oct 2010) Storage and Handling of Liquefied and Gaseous Compressed Gases and Their Full and Empty Cylinders
<http://www.aviation.dla.mil/UserWeb/aviationengineerir>

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M (2006) MILSTRIP - Military Standard Requisitioning and Issue Procedures

MIL-STD-129 (2014; Rev R; Change 1 2018; Change 2

2019) Military Marking for Shipment and
Storage

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1

(2016; Rev L; Change 2) Obstruction
Marking and Lighting

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61

National Emission Standards for Hazardous
Air Pollutants

40 CFR 82

Protection of Stratospheric Ozone

49 CFR 173.301

Shipment of Compressed Gases in Cylinders
and Spherical Pressure Vessels

1.2 PROJECT DESCRIPTION

The work under this section consists of requirements for demolition and deconstruction of existing structures and utilities; removal of materials and equipment to be salvaged, reused or disposed of; and other miscellaneous and incidental items and removals necessary for the NOAA OMAO Ship & Support Facility Relocation project at Naval Station Newport, RI. The Contractor shall furnish all materials, labor, equipment, utilities, and incidental items necessary to complete the demolition and deconstruction work as indicated on the project drawings and specified herein.

1.2.1 Definitions

1.2.1.1 Demolition

Demolition is the process of wrecking or taking out any load-supporting structural member of a facility together with any related handling and disposal operations.

1.2.1.2 Demolition Plan

Demolition Plan is the planned steps and processes for managing demolition activities and identifying the required sequencing activities and disposal mechanisms.

1.2.2 Demolition/Deconstruction Plan

Prepare a Demolition Plan and submit proposed salvage, demolition, deconstruction, and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Coordinate with Waste Management Plan in accordance with Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved

by Contracting Officer prior to work beginning.

1.2.3 General Requirements

Do not begin demolition or deconstruction until authorization is received from the Contracting Officer. The work of this section is to be performed in a manner that maximizes the value derived from the salvage and recycling of materials. Remove rubbish and debris from the project site; do not allow accumulations. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements or pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove snow, dust, dirt, and debris from work areas daily.

1.3.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

1.3.3 Trees

Protect trees within the project site which might be damaged during demolition or deconstruction, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.3.4 Utility Service

Maintain existing utilities to stay in service and protect against damage during demolition operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor.

1.3.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Demolition Plan; G
Existing Conditions

SD-07 Certificates

Notification; G

SD-11 Closeout Submittals

Receipts

1.6 QUALITY ASSURANCE

Submit timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSP A10.6. Comply with the Environmental

Protection Agency requirements specified. Use of explosives will not be permitted.

1.6.1 Dust and Debris Control

Prevent the spread of dust and debris and avoid the creation of a nuisance in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to aircraft.

1.7 PROTECTION

1.7.1 Traffic Control Signs

a. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning such work.

Provide a minimum of 2 FAA type L-810 steady burning red obstruction lights on temporary structures (including cranes) over 100 feet, but less than 200 ft, above ground level. The use of LED based obstruction lights are not permitted. For temporary structures (including cranes) over 200 ft above ground level provide obstruction lighting in accordance with FAA AC 70/7460-1. Light construction and installation shall comply with FAA AC 70/7460-1. Lights shall be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer. Maintain the temporary services during the period of construction and remove only after permanent services have been installed and tested and are in operation.

1.7.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the Contracting Officer.

1.9 EXISTING CONDITIONS

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems,

the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

PART 2 PRODUCTS

2.1 FILL MATERIAL

- a. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition or deconstruction of structures.
- b. Fill material shall conform to the definition of satisfactory soil material as defined in AASHTO M 145, Soil Classification Groups A-1, A-2-4, A-2-5 and A-3. In addition, fill material shall be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 2 inches in any dimension.
- c. Proposed fill material must be sampled and tested by an approved soil testing laboratory, as follows:

Soil classification	AASHTO M 145
Moisture-density relations	AASHTO T 180, Method B or D

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

3.1.1 Structures

- a. Remove existing structures indicated to be removed to 1 foot below grade. Remove sidewalks, curbs, gutters and street light bases as indicated.
- b. Demolish structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed. Demolish concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the Contracting Officer.
- c. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

- d. Building, or the remaining portions thereof, not exceeding 80 feet in height may be demolished by the mechanical method of demolition.

3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

3.1.3 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas. Remove gates as whole units. Cut chain link fabric to 25 foot lengths and store in rolls off the ground.

3.1.4 Paving and Slabs

Remove sawcut concrete and asphaltic concrete paving and slabs as indicated. Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the Contracting Officer. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.1.5 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.1.6 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for recycle structural steel, steel joists, girders, angles, plates, columns and shapes. Flame-cutting torches are permitted when other methods of dismantling are not practical. Transport steel joists and girders as whole units and not dismantled. Transport structural steel shapes to a designated recycling facility, stacked according to size, type of member and length, and stored off the

ground, protected from the weather.

3.1.7 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

3.1.8 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

- a. Concrete and Masonry: Completely fill holes and depressions, left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

3.1.9 Air Conditioning Equipment

Remove air conditioning, refrigeration, and other equipment containing refrigerants without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990.

3.1.10 Locksets on Swinging Doors

Remove all locksets from all swinging doors indicated to be removed and disposed of. Deliver the locksets and related items to a designated location for receipt by the Contracting Officer after removal.

3.1.11 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Disconnect mechanical equipment and fixtures at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated storage area as directed by the Contracting Officer. Do not remove equipment until approved. Do not offer low-efficiency equipment for reuse.

3.1.11.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store

flammable, explosive, or other dangerous liquids, shall be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

3.1.11.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable, as scrap metal.

3.1.11.3 Fixtures, Motors and Machines

Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or otherwise unserviceable as debris to be disposed of by the Contractor.

3.1.12 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

3.1.12.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

3.1.12.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3.1.12.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices

from the busway and store separately.

3.1.12.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.1.13 Items With Unique/Regulated Disposal Requirements

Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition or deconstruction work in areas occupied by structures to be demolished or deconstructed until all demolition and deconstruction in the area has been completed and debris removed. Fill holes, open basements and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.3.2 Reuse of Materials and Equipment

Remove and store materials and equipment indicated to be reused or relocated to prevent damage, and reinstall as the work progresses. Coordinate the re-use of materials and equipment with the re-use requirements in accordance with Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL. Capture re-use of materials in the diversion calculations for the project.

3.3.3 Salvaged Materials and Equipment

Remove materials and equipment that are indicated to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site.

- a. Salvage items and material to the maximum extent possible.
- b. Store all materials salvaged for the Contractor as approved by the

Contracting Officer and remove from Government property before completion of the contract. Coordinate the salvaged materials with tracking requirements in accordance with Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL. Capture salvaged materials in the diversion calculations for the project.

- c. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers. Deliver the following items reserved as property of the Government to the areas designated: Construction Trailer, Electrical Transformer
- d. Remove the following items reserved as property of the using service prior to commencement of work under this contract: Construction Trailer, Electrical Transformer
- e. Remove historical items in a manner to prevent damage. Deliver the following historical items to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.
- f. Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and turn in to the Navy as directed by the Commanding Officer.

3.3.4 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be removed from Government property and disposed of in accordance with 40 CFR 82. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82. Submit Receipts or bills of lading, as specified. Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

3.3.4.1 Special Instructions

No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

- a. Activity name and unit identification code
- b. Activity point of contact and phone number
- c. Type of ODS and pounds of ODS contained
- d. Date of shipment
- e. National stock number (for information, call (804) 279-4525).

3.3.4.2 Fire Suppression Containers

Deactivate fire suppression system cylinders and canisters with electrical charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.3.5 Transportation Guidance

Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.3.6 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material.

3.4 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified in the Waste Management Plan.

3.5.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property.

3.5.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and deconstruction structures to designated spoil areas on Government property.

3.5.4 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.6 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

-- End of Section --

SECTION 02 61 13

EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL
02/10, CHG 1: 02/21

PART 1 GENERAL

The waterfront and pier landing areas are an Installation Restoration (IR) site. Any excavation in these areas may encounter soil/ground water contamination that will require special handling and disposal procedures. Refer to Specification Attachment A - Final Field Investigation Report for NOAA OMAO Ship and Support Facility Relocation (April 2021). For bidding purposes, assume 100% of excavated material in these areas will be contaminated. Also refer to Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D2487	(2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D5434	(2012) Field Logging of Subsurface Explorations of Soil and Rock
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1926	Safety and Health Regulations for

Construction

40 CFR 302

Designation, Reportable Quantities, and
Notification

Rhode Island Department of Environmental Management (RIDEM)

DEM-DSR-01-93

Rules and Regulations for the
Investigation and Remediation of Hazardous
Material Releases, Short Title:
Remediation Regulations

1.2 DESCRIPTION OF WORK

The work consists of excavation and temporary storage of contaminated material (e.g., Pier Landing and B11 Parking Area as shown in the design drawings). Characterization data on the nature and extent of the contaminated material at the Pier Landing is presented in the April 2021 Final Field Investigation Report for NOAA OMAO Ship and Support Facility Relocation (Figures 5-1 and 5-2) and includes benzo(a)pyrene and arsenic in soil and poly- and perfluoroalkyl substances (PFAS) in groundwater (see Attachment A) Final Field Investigation Report for NOAA OMAO Ship and Support Facility Relocation (April 2021). Characterization data on the nature and extent of contaminated material at B11 Parking Area is presented in the April 2021 Final Field Investigation Report for NOAA OMAO Ship and Support Facility Relocation (Figure 5-7) and includes arsenic in soil (see Attachment A). Subsurface conditions are presented in the April 2021 Final Field Investigation Report for NOAA OMAO Ship and Support Facility Relocation (Table 5-1 for Pier Landing and Table 5-11 for B11 Parking Area). The results of these reports will serve as a general characterization of soils, however, the heterogeneity of the soil and backfill require that any soil removed from the site be characterized by quantitative chemical analysis. Submit a Soil and Contaminated Material Management Plan as specified below to characterize the soil.

Notify the Contracting Officer within 72 hours, and before excavation. Backfill material is not available onsite. Groundwater was reported to be approximately six to ten feet below pre-excavation ground surface during site investigation activities in 2021 and between 9 and 25 feet bgs during geotechnical evaluation at Pier Landing. Seasonal perched water table conditions must be anticipated at a depth of approximately 4 feet below the existing ground surface. Groundwater was not encountered in the proposed B11 Parking Area. The geotechnical report is provided in Final Design Geotechnical Data Report, Haley & Aldrich, Inc., 2021. For excavated soil designated for off-site disposal, conduct required sampling and chemical analysis in accordance with disposal facility requirements. Include Resource Conservation Recovery Act (RCRA) metals and semi-volatile organic compounds (SVOCs) analysis using toxicity characteristic leaching procedure (TCLP) United States Environmental Protection Agency (USEPA) Method 1311 and asbestos analysis using USEPA Method 600/R93/116 for Pier Landing soil and RCRA metals analysis using TCLP USEPA Method 1311 for B11 Parking Area soils.

In addition, as relevant for Site 19/Operable Unit (OU) 12 (or other areas with visible signs of potential asbestos debris) and documented in the ROD, recent construction activities may have resulted in a release of asbestos containing material (ACM). Asbestos-contaminated land surveys should be performed by a certified asbestos contractor within OU12 with analysis by polarized light microscopy (PLM) to characterize pre-excavated

soils.

Manage contaminated excavated soil and water (i.e., from potential construction dewatering) in accordance with this Section and all local, state, and federal regulations.

Activities under this section must be performed in accordance with 29 CFR 1910.120, including use of personnel who are OSHA 40-hour trained with updated annual 8-hour refresher certification.

1.2.1 Scheduling

Notify the Contracting Officer 10 calendar days prior to the start of excavation of contaminated material. The Contracting Officer will be responsible for contacting regulatory agencies in accordance with the applicable reporting requirements.

1.2.2 Work Plan

Submit a Work Plan within 30 calendar days after notice to proceed and 60 days in advance of the start of excavation. The Work Plan is to be submitted to the NAVSTA Environmental Office who in the case of excavations within installation restoration sites (e.g., IR Site 19) will additionally identify regulators and stakeholders (i.e., CERCLA review team) to whom the Work Plan is also to be submitted. Do not excavate until the Work Plan is approved by the Environmental Office and as applicable, regulators and stakeholders. No adjustment for time or money will be made if resubmittals of the Work Plan are required due to deficiencies in the plan. At a minimum, the Work Plan must include:

- a. Schedule of activities.
- b. Method of excavation and equipment to be used.
- c. Shoring or side-wall slopes proposed.
- d. Dewatering plan.
- e. Storage methods and locations for liquid and solid contaminated material.
- f. Borrow sources and haul routes.
- g. Decontamination procedures.
- h. Spill contingency plan.
- i Results from asbestos-contaminated land survey (OU12 only, or as required based on field observation).
- j. Planned offsite disposal facilities.

1.2.3 Other Submittal Requirements

Submit test results, and 2 copies of the Closure Report within 14 calendar days of work completion at the site.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Work Plan; G

Soil and Contaminated Material Management Plan; G

Dig Permit; G

SD-02 Shop Drawings

Surveys

SD-06 Test Reports

Compaction

Closure Report; G

Waste Determination Forms

Waste Manifest; G

1.4 REGULATORY REQUIREMENTS

1.4.1 Permits and Licenses

Obtain required federal, state, and local permits for excavation and storage of contaminated material. Obtain permits at no additional cost to the Government.

1.4.2 Air Emissions

Monitor and control air emissions in accordance with Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS. Employ dust suppression (i.e. watering) techniques at all times during earth work.

PART 2 PRODUCTS

2.1 SPILL RESPONSE MATERIALS

Provide appropriate spill response materials including, but not limited to the following: containers, adsorbents, shovels, and personal protective equipment. Ensure spill response materials are available at all times when contaminated materials and wastes are being handled or transported. Use spill response materials compatible with the type of materials and contaminants being handled.

2.2 BACKFILL

Obtain backfill material from offsite sources approved by the Contracting Officer. Classify backfill in accordance with ASTM D2487 as GW, GP, GM, SW, SP, or SM and must be free from roots and other organic matter, trash,

debris, snow, ice or frozen materials. Test backfill material to ensure that the material meets RIDEM's Residential Direct Exposure Criteria (RDEC), as defined by the Remediation Regulations (DEM-DSR-01-93) (Tables 1 and 2), for all constituents plus TPH at a frequency of once per 3000 cubic yards. Perform a minimum of one set of classification tests shall be performed per borrow source in accordance to Section 31 23 00.00 20 EXCAVATION AND FILL.

Do not use material for backfill until borrow source chemical and physical test results have been submitted and approved.

PART 3 EXECUTION

3.1 EXISTING STRUCTURES AND UTILITIES

Locate site utilities before the start of excavation and submit a Dig Permit Request to NAVSTA Newport including a DIG Safe Request Form "B". Take the necessary precautions to ensure no damage occurs to existing structures and utilities. Damage to existing structures and utilities resulting from the Contractor's operations must be repaired at no additional cost to the Government. Obtain approval from the Contracting Office before disturbing utilities encountered that were not previously shown or otherwise located.

3.2 CLEARING

Perform clearing to the limits shown on the drawings in accordance with Section 31 11 00 CLEARING AND GRUBBING.

3.3 CONTAMINATED MATERIAL REMOVAL

3.3.1 Soil and Contaminated Material Management Plan

Provide a Soil and Contaminated Material Management Plan that is prepared under the direction of professional engineer licensed in Rhode Island, who must sign and seal said plan and all revisions and submit to the Contracting Officer no later than 30 days prior to excavating. List in the Soil and Contaminated Material Management Plan the methods and details to be used to determine if excavated materials are contaminated, and the methods and details to be used to handle contaminated soils and water in the vicinity of the work during construction. The Soil and Contaminated Material Management Plan must include proposed methods of storing, protecting, placing and compacting contaminated soils, or transport and offsite disposal, as applicable. Refer to Attachment B Table 1 in Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS when designating soils for on-site reuse or for offsite disposal. Soil designated for on-site reuse must also meet the requirements for intended use pursuant to 31 23 00.00 20 (EXCAVATION AND FILL).

Excess polluted/contaminated soil that cannot be reused must be characterized for off-site disposal. Determine analytical requirements for off-site disposal specified by the receiving facilities.

As part of the Soil and Contaminated Material Management Plan, provide a written description of the process and materials for use in amending and solidifying excavated materials that contain free draining liquids, for the purpose of handling, transportation, and disposal. Solidification materials must not be contaminated or hazardous and must be in a dry state prior to use in solidification operations. The maximum quantity of

solidification material will be limited to twenty (20) percent by volume, of the material being solidified.

3.3.2 Excavation

Excavate areas of contamination to the depth and extent shown on the drawings and not more than 0.2 feet beyond the depth and extent shown on the drawings unless directed by the Contracting Officer. Excavate in a manner that will limit spills and the potential for contaminated material to be mixed with uncontaminated material. Maintain an excavation log describing visible signs of contamination encountered for each area of excavation. Prepare excavation logs in accordance with ASTM D5434.

3.3.3 Shoring

Evaluate, shore, slope or brace the excavation if workers must enter as required by EM 385-1-1 and 29 CFR 1926 section 650.

3.3.4 Dewatering

Divert surface water to prevent entry into the excavation. Limit dewatering to the amount necessary to assure adequate access, a safe excavation, prevent the spread of contamination, and to ensure that compaction requirements can be met. Do not perform dewatering without prior approval of the Contracting Officer. Capture, sample, and dispose of dewatering effluent in accordance with all local, state, and federal laws. Sample the dewatering effluent in accordance with paragraph SAMPLING LIQUID.

3.4 SOIL AND CONTAMINATED MATERIAL STORAGE

Place contaminated material in temporary storage for no longer than 90 days immediately after excavation. The following paragraphs describe approved methods of material storage. Ensure storage units are watertight and clean and constructed of metal or plastic. Clearly label each storage unit with an identification number and keep a written log to track the source of contaminated material in each temporary storage unit.

3.4.1 Stockpiles

Construct stockpiles to isolate stored uncharacterized excavated soil and contaminated material from the environment. The maximum stockpile size is 3000 cubic yards. Do not stockpile contaminated soil on-site for more than 60 days without a request for prior approval from the NAVSTA Newport Environmental Office for stockpiling soil for more than 60 days. Construct stockpiles to include:

- a. A chemically resistant geomembrane liner free of holes and other damage. Non-reinforced geomembrane liners must have a minimum thickness of 20 mils. Scrim reinforced geomembrane liners must have a minimum weight of 40 lbs/1000 square feet. The ground surface on which the geomembrane is to be placed must be free of rocks greater than 0.5 inches in diameter and any other object which could damage the membrane.
- b. Geomembrane cover free of holes or other damage to prevent precipitation from entering the stockpile. Non-reinforced geomembrane covers must have a minimum thickness of 10 mils. Scrim reinforced geomembrane covers must have a minimum weight of 26 lbs/1000 square

feet. Extend the cover material over the berms and anchored or ballasted to prevent it from being removed or damaged by wind.

- c. Berms surrounding the stockpile, a minimum of 12 inches in height. Berm vehicle access points to a minimum of 12 inches in height.
- d. Slope the liner system to allow collection of leachate. Store and remove of liquid which collects in the stockpile, in accordance with paragraph Liquid Storage.

3.4.2 Roll-Off Units

Roll-off units used to temporarily store contaminated material must be water tight. Place a cover over the units to prevent precipitation from contacting the stored material. The units must be located as close to the excavation area as possible. Remove and store liquid which collects inside the units in accordance with paragraph Liquid Storage.

3.4.3 Liquid Storage

Temporarily store liquid collected from excavations and stockpiles for no longer than 90 days in 55 gallon barrels or 500 gallon tanks depending on the volume. Liquid storage containers must be water-tight and shall be located at a staging area designated by the Naval Station Environmental Manager.

3.5 SAMPLING

3.5.1 Sampling of Stored Material

Samples of stored material (e.g., excavated soil) shall be collected at a frequency of once per 500 cubic yards. Samples shall be tested for the contaminants of concern.

For soil or containerized ground water (i.e., dewatering) designated for off-site disposal, additionally, collect samples of stored material at a frequency and for parameters specified by the disposal facility for characterization and disposal. Include RCRA metals and SVOCs analysis using TCLP USEPA Method 1311 and asbestos analysis using USEPA Method 600/R93/116 for stored material from the Pier Landing. Include RCRA metals analysis using TCLP USEPA Method 1311 for stored material from the B11 Parking Area. Analytical requirements for off-site disposal are summarized in the tables below, not including any additional analysis required by the disposal facility. Analyses for stored material must conform to local, state, and federal criteria. Provide documentation of all analyses performed to the Contracting Officer.

Stored Material Analytes

Pier Landing	Method
RCRA Metals	USEPA Method 1311 TCLP
SVOCs	USEPA Method 1311 TCLP
Asbestos	USEPA Method 600/R93/116

Pier Landing	Method
B11 parking Area	Method
RCRA Metals	USEPA Method 1311 TCLP

Liquid Analytes

Pier Landing	Method
RCRA Metals	USEPA Method 1311 TCLP
SVOCs	USEPA Method 1311 TCLP
B11 Parking Area	Method
RCRA Metals	USEPA Method 1311 TCLP

3.5.2 Sampling Liquid

Sample liquid collected from excavations storage areas decontamination facilities at a frequency of once for every 500 gal of liquid collected. Analyses for collected liquid must conform to local, state, and federal criteria as well as to the requirements of the disposal facility. Include RCRA metals and SVOCs analysis using TCLP USEPA Method 1311 for collected liquid from Pier Landing. Include RCRA metals analysis using TCLP USEPA Method 1311 for collected liquid from B11 Parking Area. Provide documentation of all analyses performed to the Contracting Officer.

3.6 SPILLS

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), pollutant, contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), notify the Contracting Officer immediately. If the spill exceeds the reporting threshold, follow the pre-established procedures as described in the Facility Response Plan and Spill Prevention Control and Countermeasure Plan for immediate reporting and containment. Take immediate containment actions to minimize the effect of any spill or leak. Cleanup in accordance with applicable federal, state, and local regulations. Perform additional sampling and testing as directed by the Contracting Officer, to verify spills have been cleaned up. Complete spill cleanup and testing at no additional cost to the Government.

3.7 BACKFILLING

Backfill excavations immediately after all contaminated materials have been removed. Place and compact backfill to the lines and grades shown on the drawings. Ensure Pier Landing is recapped with approved engineered controls (i.e., 6 inches of a clean soil encapsulation and cover system, 2 inches of asphalt, or concrete) in accordance with the EPA Record of Decision for Site 19 - On-Shore Dredge Shipyard Operable Unit 12, September 2014. Ensure B11 Parking Area is recapped with approved engineered controls (i.e., 2 feet of clean fill or equivalent; building foundations; 4 inches of pavement or concrete underlain with 6 inches of clean fill; of 1 foot of clean fill underlain with a geotextile liner).

3.7.1 Compaction

Place approved backfill in lifts with a maximum loose thickness of 6 inches. Compact soil to 90 percent of ASTM D1557 maximum dry density. Conduct a minimum of one density test on each lift of backfill placed. Determine field in-place dry density in accordance with ASTM D1556/D1556M or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556/D1556M density test at a location already ASTM D6938 tested as specified herein. Perform an ASTM D1556/D1556M density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut. Refer to Section 31 23 00.00 20 EXCAVATION AND FILL for more details.

3.8 DISPOSAL REQUIREMENTS

Soil that is not a hazardous waste shall be disposed of or reused in accordance with this section and Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS. Attachment B Table 1. Soil designated for on-site reuse must also meet the requirements for intended use pursuant to 31 23 00.00 20 (EXCAVATION AND FILL).

Soil designated for off-site disposal and that has been determined to be hazardous waste shall be disposed of in accordance with Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS and Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

3.9 CLOSURE REPORT

Submit two copies of a Closure Report within 14 calendar days of completing work at the site to the Contracting Officer. The report must be labeled with the contract number, project name, location, date, name of general Contractor, and the Corps of Engineers District contracting for the work. Include the following information at a minimum in the Closure Report:

- a. A cover letter signed by a Professional Engineer registered in the State of Rhode Island who is a responsible company official certifying that all services involved have been performed in accordance with the terms and conditions of the contract documents and regulatory requirements.
- b. A narrative report including, but not limited to, the following:
 - (1) site conditions, ground water elevation, and cleanup criteria;
 - (2) excavation logs;
 - (3) field screening readings;
 - (4) quantity of materials removed from each area of contamination;
 - (5) quantity of water/product removed during dewatering;
 - (6) sampling locations and sampling methods;

- (7) sample collection data such as time of collection and method of preservation;
- (8) sample chain-of-custody forms; and
- (9) source of backfill.
- c. Copies of all chemical and physical test results.
- d. Copies of all manifests and land disposal restriction notifications.
- e. Copies of all certifications of final disposal signed by the responsible disposal facility official.
- f. Waste profile sheets.
- g. Scale drawings showing limits of each excavation, limits of contamination, known underground utilities within 50 feet of excavation, sample locations, and sample identification numbers. Show on-site stockpile, storage, treatment, loading, and disposal areas shall also be shown on the drawings.
- h. Progress Photographs. Use color photographs shall be used to document progress of the work. Take a minimum of four views of the site showing the location of the area of contamination, entrance/exit road, and any other notable site conditions shall be taken before work begins. After work has been started, photographically record weekly activities at each work location. Photographs must be a minimum of 3 by 5 inches and shall include:
 - (1) Soil removal and sampling.
 - (2) Dewatering operations.
 - (3) Unanticipated events such as spills and the discovery of additional contaminated material.
 - (4) Contaminated material/water storage, handling, treatment, and transport.
 - (5) Site or task-specific employee respiratory and personal protection.
 - (6) Fill placement and grading.
 - (7) Post-construction photographs. After completion of work at each site, take a minimum of four views of each excavation site.

Include digital version of all photos shown in the report with the Closure Report. Photographs must be a minimum of 3 inches by 5 inches and shall be mounted back-to-back in double face plastic sleeves punched to fit standard three ring binders. Include an information box attached to each print. The box must be typewritten and arranged as follows:

Project Name:	Direction of View:
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Location:	Date/Time:
Photograph No.:	Description of View:

-- End of Section --

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SECTION 02 81 00

TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS
11/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

DOT 4500.9R	Defense Transportation Regulation, Part 2, Cargo Movement, Chapter 204, Hazardous Material
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 302	Designation, Reportable Quantities, and Notification
49 CFR 107	Hazardous Materials Program Procedures

49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

RHODE ISLAND DEPARTMENT OF STATE

250-RICR-140-10-1	Rules and Regulations for Hazardous Waste Management
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RHODE ISLAND GENERAL LAWS

31-23-37	Transporting Hazardous Substances
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Hazardous Material Minimization Centers (HAZMIN)

OPNAVINST 4110.2	Hazardous Material Control and Management Program
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1.2 DEFINITIONS

1.2.1 Hazardous Material

A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated pursuant to the Hazardous Materials Transportation Act, 49 U.S.C. Appendix Section 1801 et seq. The term includes materials designated as hazardous materials under the provisions of 49 CFR 172, Sections .101 and .102 and materials which meet the defining criteria for hazard classes and divisions in 49 CFR 173. EPA designated hazardous wastes are also hazardous materials.

1.2.2 Hazardous Waste

A waste which meets criteria established in RCRA or specified by the EPA in 40 CFR 261 or which has been designated as hazardous by a RCRA authorized state program.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Packaging Notifications

Hazardous Waste Management Plan; G

Onsite Hazardous Waste Management; G

Notices of Non-Compliance and Notices of Violation

SD-06 Test Reports

Recordkeeping; G

Exception Report; G

Spill Response

SD-07 Certificates

Transportation and Disposal Coordinator; G

Training; G

Certification

Shipping Documents and Packaging Certification; G

Security Plan

Certificates of Disposal

Waste Minimization

1.4 QUALITY ASSURANCE

1.4.1 Transportation and Disposal Coordinator

Designate, by position and title, one person to act as the Transportation and Disposal Coordinator (TDC) for this contract. The TDC must serve as the single point of contact for all environmental regulatory matters and have overall responsibility for total environmental compliance at the site including, but not limited to, accurate identification and classification of hazardous waste and hazardous materials; determination of proper shipping names; identification of marking, labeling, packaging and placarding requirements; completion of waste profiles, hazardous waste manifests, asbestos waste shipment records, bill of lading, exception and discrepancy reports; Off-Site Rule packages in accordance to 40 CFR 300; and all other environmental documentation. The TDC must have, at a minimum, one year of specialized experience in the management and transportation of hazardous waste and have been Department of Transportation certified under 49 CFR 172, Subpart H.

1.4.2 Training

Train, test and certify hazardous materials employees to safely and effectively carry out their assigned duties in accordance with Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES. Train, test, and certify employees transporting hazardous materials or preparing hazardous materials for transportation, including samples, in accordance with 49 CFR 172, Subpart H, including security awareness and any applicable security plans. Train, test, and certify employees in accordance with 49 CFR 172, Subpart H to determine that shipments do not constitute DOT regulated hazardous materials.

1.4.3 Certification

The hazardous materials transporter must possess a current certificate of registration issued by the Research and Special Programs Administration (RSPA), U.S. Department of Transportation, when required by 49 CFR 107, Subpart G. Submit copies of the certificates or written statements certifying exemption from these requirements.

1.4.4 Laws and Regulations Requirements

Comply with Federal, state, and local laws and regulations addressing transportation and management of hazardous materials including but not limited to DOT 4500.9R, OPNAVINST 4110.2, Rhode Island Department of State 250-RICR-140-10-1, and Rhode Island General Law 31-23-37. These requirements are amended frequently and compliance with amendments is required as they become effective. Notify the Contracting Officer immediately if compliance exceeds the scope of work or conflicts with specific requirements of the contract.

PART 2 PRODUCTS

2.1 MATERIALS

Provide all the materials required for the packaging, labeling, marking, placarding and transportation of hazardous wastes and hazardous materials in conformance with Department of Transportation standards OPNAVINST 4110.2, NAVSTA Newport Hazardous Materials Management Plan, and Rhode Island General Law 31-23-37. Details in this specification must not be construed as establishing the limits of the Contractor's responsibility.

2.1.1 Packaging

Provide bulk and non-bulk containers for packaging hazardous materials/wastes consistent with the authorizations referenced in the Hazardous Materials Table in 49 CFR 172, Section.101, Column 8. Bulk and non-bulk packaging must meet the corresponding specifications in 49 CFR 173 referenced in the Hazardous Materials Table, 49 CFR 172, Section .101. Packaging must conform to the general packaging requirements of Subpart B of 49 CFR 173, to the requirements of 49 CFR 178 at the specified packing group performance level, to the requirements of special provisions of column 7 of the Hazardous Materials Table in 49 CFR 172, Section .101, and be compatible with the material to be packaged as required by 40 CFR 262. Also provide other packaging related materials such as materials used to cushion or fill voids in overpacked containers. The hazardous materials being packaged must not react dangerously with, decompose or ignite the sorbent packaging materials. Additionally, sorbents used to treat free liquids to be disposed of in landfills must be non-biodegradable as specified in 40 CFR 264, Section .314. In addition, packaging notifications will be provided to the Government in accordance with 49 CFR 172, Section .178.2(c) regarding type and dimensions of closures, including gaskets, needed to satisfy performance test requirements.

2.1.2 Markings

Provide markings for each hazardous material/waste package, freight container, and transport vehicle consistent with the requirements of 49 CFR 172, Subpart D and 40 CFR 262, Section.32 (for hazardous waste) 40 CFR 61, Section .149(d) (for asbestos). Markings must withstand a 180 day exposure to conditions reasonably expected to be encountered during

container storage and transportation, without deterioration or substantial color change.

2.1.3 Labeling

Provide primary and subsidiary labels for hazardous materials/wastes consistent with the requirements in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 6. Labels must meet design specifications required by 49 CFR 172, Subpart E including size, shape, color, printing, and symbol requirements. Labels must be durable weather resistant and withstanding a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation, without deterioration or substantial color change.

2.1.4 Placards

For each offsite shipment of hazardous material/waste, provide primary and subsidiary placards consistent with the requirements of 49 CFR 172, Subpart F. Provide placards for each side and each end of bulk packaging, freight containers, transport vehicles, and rail cars requiring such placarding. Placards may be plastic, metal, or other material capable of withstanding, without deterioration, a 30 day exposure to open weather conditions and must meet design requirements specified in 49 CFR 172, Subpart F.

2.1.5 Spill Response Materials

Provide spill response materials including, but not limited to, containers, adsorbent, shovels, and personal protective equipment. Spill response materials must be available at all times when hazardous materials/wastes are being handled or transported. Spill response materials must be compatible with the type of material being handled.

2.2 EQUIPMENT AND TOOLS

Provide miscellaneous equipment and tools necessary to handle hazardous materials and hazardous wastes in a safe and environmentally sound manner.

PART 3 EXECUTION

3.1 HAZARDOUS WASTE MANAGEMENT PLAN

Prepare a Hazardous Waste Management Plan detailing the manner in which hazardous wastes will be managed and describing the types and volumes of hazardous wastes anticipated to be managed. The plan must address both onsite and offsite hazardous waste management. Describe the methods to be used to ensure accurate piece counts or weights of shipments; describe waste minimization methods; identify and describe facilities to be used for treatment, storage, and disposal (TSD); identify areas onsite where hazardous wastes are to be handled; and identify whether transfer facilities are to be used; and if so, how the wastes will be tracked to ultimate disposal. Submit the plan to the Contracting Officer for approval prior to start of work. Submit written documentation of weekly hazardous waste inspections on a monthly basis.

3.2 ONSITE HAZARDOUS WASTE MANAGEMENT

Coordinate the onsite management of all hazardous materials and waste with the installation environmental function and the Contracting Officer.

These paragraphs apply to Government owned waste only. The Contractor is responsible for ensuring compliance with Federal, state, and local hazardous waste laws and regulations and verifying those requirements when preparing reports, waste shipment records, hazardous waste manifests, or other documents. Identify hazardous wastes using criteria set forth in 40 CFR 261 or applicable state and local laws, regulations, and ordinances. Comply with generator requirements in 40 CFR 262 when accumulating hazardous waste onsite. Restrict onsite accumulation times must be restricted to applicable time frames referenced in 40 CFR 262, Section.34 and in accordance with SECTION 02 61 13: EXCAVATION AND HANDLING OF CONTAMINATED MATERIALS. Accumulation start dates commence when waste container is transferred into a 90 day accumulation site or permitted storage facility. Only use containers in good condition and compatible with the waste to be stored. Ensure containers are closed except when adding or removing waste, and immediately mark all hazardous waste containers with the words "hazardous waste" and other information required by 40 CFR 262, Section.32 as soon as the waste is containerized. Place an additional marking on containers of "unknowns" designating the date sampled, and the suspected hazard. Inspect containers for signs of deterioration and for responding to any spills or leaks. Inspect all hazardous waste areas weekly and provide written documentation of the inspection. Include date and time of inspection, name of individual conducting the inspection, problems noted, and corrective actions taken on the inspection logs.

3.2.1 Hazardous Waste Classification

Identify, in consultation with the waste generator and Naval Station (NAVSTA) Newport, Hazardous Waste Manager, all waste codes applicable to each hazardous waste stream based on requirements in 40 CFR 261 or applicable state or local law or regulation. Also identify applicable treatment standards in 40 CFR 268 and state land disposal restrictions and make a determination as to whether or not the waste meets or exceeds the standards. Submit waste profiles, analyses, classification and treatment standards information to Contracting Officer for review and approval.

3.3 OFFSITE HAZARDOUS WASTE MANAGEMENT

Coordinate the off-site transfer of all hazardous materials and waste with the installation environmental function and the Contracting Officer. Use RCRA Subtitle C permitted facilities which meet the requirements of 40 CFR 264 or facilities operating under interim status which meet the requirements of 40 CFR 265. Do not use offsite treatment, storage, and disposal facilities with significant RCRA violations or compliance problems (such as facilities known to be releasing hazardous constituents into ground water, surface water, soil, or air). Submit Notices of Non-Compliance and Notices of Violation by a Federal, state, or local regulatory agency issued to the Contractor in relation to any work performed under this contract. Immediately provide copies of such notices to the Contracting Officer. Also furnish relevant documents regarding the incident and any information requested by the Contracting Officer, and coordinate its response to the notice with the Contracting Officer or the designated representative prior to submission to the notifying authority. Also furnish a copy to the Contracting Officer of all documents submitted to the regulatory authority, including the final reply to the notice, and all other materials, until the matter is resolved.

3.3.1 Treatment, Storage, and Disposal Facility and Transporter

Provide the Contracting Officer with EPA ID numbers, names, locations, and telephone numbers of TSD facilities and transporters and include in the Off-site Rule package. Include this information in the Hazardous Waste Management Plan and get approval by the Contracting Officer prior to waste disposal.

3.3.2 Facility Status Information

Facilities receiving hazardous waste must be permitted in accordance with 40 CFR 270 or operating under interim status in accordance with 40 CFR 265 requirements, or permitted by a state authorized by the Environmental Protection Agency to administer the RCRA permit program. Additionally, prior to using a TSD Facility, contact the EPA Regional Offsite Coordinator specified in 40 CFR 300, Section .440, to determine the facility's status, and document all information necessary to satisfy the requirements of the EPA Offsite policy and submit this information to the Contracting Officer in the Hazardous Waste Management Plan.

3.3.3 Shipping Documents and Packaging Certification

Prior to shipment of any hazardous material offsite and a minimum of 14 days prior to anticipated pickup, provide for review written certification to the Contracting Officer that hazardous materials have been properly packaged, labeled, and marked in accordance with Department of Transportation and EPA requirements. Furnish designated disposal facility packaging assurances not later than 35 days after acceptance of the shipment. The Contractor's TDC must also provide written certification regarding waste minimization efforts documenting that efforts have been taken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

3.3.4 Transportation

Prior to conducting hazardous materials activities, the Contractor responsible for pre-transportation activities must either certify to the Government that a Security Plan is in place which meets the requirements of 49 CFR 172, Subpart I or in the event that the types or amounts of hazardous materials are excluded from the security planning requirements, a written statement to that effect detailing the basis for the exception. Use manifests for transporting hazardous wastes as required by 40 CFR 263 or applicable state or local law or regulation. Transportation must comply with all requirements in the Department of Transportation referenced regulations in the 49 CFR series. Prepare hazardous waste manifests for each shipment of hazardous waste shipped offsite. Complete manifests using instructions in 40 CFR 262, Subpart B and applicable state or local law or regulation. Submit manifests and waste profiles to Contracting Officer for review, approval and signature. Prepare land disposal restriction notifications as required by 40 CFR 268 or applicable state or local law or regulation for each shipment of hazardous waste. Submit notifications with the manifest to the Contracting Officer for review, approval, and signature.

3.3.5 Treatment and Disposal of Hazardous Wastes

Coordinate any off-site shipments of hazardous materials or hazardous wastes with the installation environmental function. Initial, or

satellite hazardous waste accumulation is limited to 55 gallons (or 1 quart of acutely hazardous waste). Once a waste stream exceeds 55 gallons, transfer it to an on-site 90 day (180 day small quantity generator) accumulation area, or a permitted hazardous waste treatment, storage or disposal facility within three days. Ship hazardous wastes only to facilities which are properly permitted to accept the hazardous waste or operating under interim status. Ensure wastes are treated to meet land disposal treatment standards in 40 CFR 268 prior to land disposal. Propose TSD facilities via submission of the Hazardous Waste Management Plan, subject to the approval of the Contracting Officer. Submit Certificates of Disposal documenting the ultimate disposal, destruction or placement of hazardous wastes, CERCLA remediation waste, within 180 days of initial shipment. Receipt of these certificates will be required for final payment.

3.4 WASTE MINIMIZATION

Minimize the generation of hazardous waste to the maximum extent practicable and take all necessary precautions to avoid mixing clean and contaminated wastes. Identify and evaluate recycling and reclamation options as alternatives to land disposal. Requirements of 40 CFR 266 apply to: hazardous wastes recycled in a manner constituting disposal; hazardous waste burned for energy recovery; lead-acid battery recycling; and hazardous wastes with economically recoverable precious metals. Submit written certification that waste minimization efforts have been undertaken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

3.5 RECORDKEEPING

Maintain adequate records to support information provided to the Contracting Officer regarding exception reports, annual reports, and biennial reports; and maintain bill of lading for a minimum of 375 days from the date of shipment or longer period required by applicable law or regulation or other provision of this contract. Submit information necessary to file state annual or EPA biennial reports for hazardous waste transported, treated, stored, or disposed of under this contract. Do not forward these data directly to the regulatory agency but to the Contracting Officer at the specified time. Submit the information necessary for filing of the formal reports in the form and format required by the governing Federal or state regulatory agency. A cover letter must accompany the data to include the contract number, Contractor name, and project location. In the event that a manifest copy documenting receipt of hazardous waste at the treatment storage and disposal facility is not received within 35 days of shipment initiation, prepare and submit an exception report to the Contracting Officer within 37 days of shipment initiation.

3.6 SPILL RESPONSE

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), or pollutant or contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), notify the Contracting Officer immediately. Direction from the Contracting Officer concerning a spill or release is not considered a change under the contract. If the spill exceeds a reporting threshold, follow the pre-established procedures for immediate reporting to the Contracting Officer. Comply with applicable requirements of Federal, state, or local laws or regulations

regarding any spill incident.

3.7 EMERGENCY CONTACTS

Comply with the emergency contact provisions in 49 CFR 172, Section .604. Whenever the Contractor ships hazardous materials, provide a 24 hr emergency response contact and phone number of a person knowledgeable about the hazardous materials being shipped and who has comprehensive emergency response and incident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information. Monitor the phone on a 24 hour basis at all times when the hazardous materials are in transportation, including during storage incidental to transportation. Ensure that information regarding this emergency contact and phone number are placed on all hazardous material shipping documents. Designate an emergency coordinator and post the following information at areas in which hazardous wastes are managed:

- a. The name of the emergency coordinator.
- b. Phone number through which the emergency coordinator can be contacted on a 24 hour basis.
- c. The telephone number of the local fire department.
- d. The location of fire extinguishers and spill control materials.

Attachment A SAMPLE OFF-SITE POLICY CERTIFICATION MEMO	
Project/Contract #:	
Waste Stream:	
Primary TSD Facility, EPA ID # and Location:	
Alter. TSD Facility, EPA ID # and Location:	
EPA Region	Contact
I	888-372-7341
II	212-673-4040
III	800-438-2474 or 215-814-5000
IV	800-241-1754 or 404-562-9900
V	312-353-2000
VI	800-887-6063 or 214-665-2210
VII	800-223-0425
VIII	800-424-8802
IX	415-947-8713
X	800-424-4372 or 206-553-4973
EPA representative contacted:	
EPA representative phone number:	
Date contacted:	
Comment:	
The above EPA representative was contacted on _____. As of that date the above sites were considered acceptable in accordance with the Off-Site Policy in 40 CFR 300.440.	
Date:	Signature:
Phone number:	

-- End of Section --

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

02/19, CHG 1: 02/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 121R	(2008) Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
ACI 301	(2016) Specifications for Structural Concrete
ACI 302.1R	(2015) Guide for Concrete Floor and Slab Construction
ACI 304.2R	(2017) Guide to Placing Concrete by Pumping Methods
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2020) Guide to Hot Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting
ACI 308.1	(2011) Specification for Curing Concrete
ACI SP-2	(2007; Abstract: 10th Edition) ACI Manual of Concrete Inspection
ACI SP-15	(2011) Field Reference Manual: Standard Specifications for Structural Concrete ACI 301-05 with Selected ACI References

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard
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AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2018) Structural Welding Code - Reinforcing Steel
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ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A934/A934M	(2016) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A1022/A1022M	(2016b) Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2021a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2020) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C78/C78M	(2021) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2021) Standard Specification for Portland Cement
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the

Volumetric Method

ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C311/C311M	(2018) Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C330/C330M	(2017a) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C552	(2017; E 2018) Standard Specification for Cellular Glass Thermal Insulation
ASTM C578	(2019) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	(2020) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C595/C595M	(2021) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C803/C803M	(2018) Standard Test Method for Penetration Resistance of Hardened Concrete
ASTM C845/C845M	(2018) Standard Specification for Expansive Hydraulic Cement
ASTM C873/C873M	(2015) Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
ASTM C900	(2015) Standard Test Method for Pullout Strength of Hardened Concrete
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1012/C1012M	(2018b) Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution

ASTM C1017/C1017M	(2013; E 2015) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1074	(2019) Standard Practice for Estimating Concrete Strength by the Maturity Method
ASTM C1077	(2017) Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1157/C1157M	(2020a) Standard Performance Specification for Hydraulic Cement
ASTM C1218/C1218M	(2020c) Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C1240	(2020) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1260	(2021) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1293	(2008; R 2015) Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
ASTM C1567	(2021) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2018) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C1778	(2016) Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D471	(2016a) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D1751	(2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2628	(1991; R 2016) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D2835	(1989; R 2017) Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
ASTM D5759	(2012; R 2020) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D6690	(2015) Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM E96/E96M	(2021) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E329	(2021) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E1155	(2020) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E1643	(2018a) Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
ASTM E1745	(2017) Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2018) Manual of Standard Practice
CRSI RB4.1	(2016) Supports for Reinforcement Used in Concrete

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	(2015) Principles and Criteria for Forest Stewardship
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NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(2009) DOC Voluntary Product Standard PS 1-07, Structural Plywood
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U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513 (1974) Corps of Engineers Specifications
for Rubber Waterstops

COE CRD-C 572 (1974) Corps of Engineers Specifications
for Polyvinylchloride Waterstops

1.2 DEFINITIONS

- a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, and slag cement.
- b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.
- c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.
- d. "Supplementary cementing materials" (SCM) include coal fly ash, slag cement, natural or calcined pozzolans, and ultra-fine coal ash when used in such proportions to replace the portland cement that result in improvement to sustainability and durability and reduced cost.
- e. "Design strength" (f'_c) is the specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.
- f. "Mass Concrete" is any concrete system that approaches a maximum temperature of 158 degrees F within the first 72 hours of placement. In addition, it includes all concrete elements with a section thickness of 3 feet or more regardless of temperature.
- g. "Mixture proportioning" is the process of designing concrete mixture proportions to enable it to meet the strength, service life and constructability requirements of the project while minimizing the initial and life-cycle cost.
- h. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic meter or cubic yard) of concrete.
- i. "Pozzolan" is a siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.
- j. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan

Quality Control Personnel Certifications

Quality Control Organizational Chart

Laboratory Accreditation

Maturity Method Data

SD-02 Shop Drawings

Reinforcing Steel; G

SD-03 Product Data

Joint Sealants

Joint Filler

Formwork Materials

Recycled Aggregate Materials

Cementitious Materials

Vapor Barrier

Concrete Curing Materials

Reinforcement

Admixtures

Waterstops

Biodegradable Form Release Agent

Nonshrink Grout

SD-05 Design Data

Concrete Mix Design; G

SD-06 Test Reports

Concrete Mix Design; G

Fly Ash

Pozzolan

Slag Cement

Aggregates

Tolerance Report

Compressive Strength Tests; G

Air Content

Slump Tests

Water

SD-07 Certificates

Reinforcing Bars

VOC Content for Form Release Agents, Curing Compounds, and
Concrete Penetrating Sealers

Safety Data Sheets

Forest Stewardship Council (FSC) Certification; S

Field Testing Technician and Testing Agency

Recycled Content; S

Regional Material; S

Legal Wood; S

SD-08 Manufacturer's Instructions

Joint Sealants

Curing Compound

1.3.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1.1 IEQ Low-Emitting Materials

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.3.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications applicable materials such as reinforcement, aggregate and cementitious materials.

Provide regional material certifications for all materials that apply such as concrete.

Provide FSC certification for wood forms.

1.3.1.3 Pilot Credit Legal Wood

Submit certifications verifying product is from Legal and Responsible Sources per ASTM D7612-10 as required to achieve LEED credit.

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Follow ACI 301, ACI 304R and ASTM A934/A934M requirements and recommendations. Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Design Data

1.6.1.1 Concrete Mix Design

Sixty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, supplementary cementitious materials, and admixtures; and applicable reference specifications. Submit mill test and all other test for cement, supplementary cementitious materials, aggregates, and admixtures. Provide documentation of maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Resubmit data on concrete components if the qualities or source of components changes. For previously approved concrete mix designs used within the past twelve months, the previous mix design may be re-submitted without further trial batch testing if accompanied by material test data conducted within the last six months. Obtain mix design approval from the contracting officer

prior to concrete placement.

1.6.2 Shop Drawings

1.6.2.1 Reinforcing Steel

Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Reproductions of contract drawings are unacceptable.

1.6.3 Control Submittals

1.6.3.1 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

1.6.3.2 Safety Data Sheets

Submit Safety Data Sheets (SDS) for all materials that are regulated for hazardous health effects. SDS must be readily accessible during each work shift to employees when they are at the construction site.

1.6.4 Test Reports

1.6.4.1 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date.

1.6.4.2 Slag Cement

Submit test results in accordance with ASTM C989/C989M for slag cement. Submit test results performed within 6 months of submittal date.

1.6.4.3 Aggregates

Submit test results in accordance with ASTM C33/C33M, or ASTM C330/C330M for lightweight aggregate, and ASTM C1293 or ASTM C1567 as required in the paragraph titled ALKALI-AGGREGATE REACTION.

1.6.5 Field Samples

1.6.6 Quality Control Plan

Develop and submit for approval a concrete quality control program in accordance with the guidelines of ACI 121R and as specified herein. The plan must include approved laboratories. Provide direct oversight for the concrete qualification program inclusive of associated sampling and testing. All quality control reports must be provided to the Contracting Officer, Quality Manager and Concrete Supplier. Maintain a copy of ACI SP-15 and CRSI 10MSP at project site.

1.6.7 Quality Control Personnel Certifications

The Contractor must submit for approval the responsibilities of the

various quality control personnel, including the names and qualifications of the individuals in those positions and a quality control organizational chart defining the quality control hierarchy and the responsibility of the various positions. Quality control personnel must be employed by the Contractor.

Submit American Concrete Institute certification for the following:

- a. CQC personnel responsible for inspection of concrete operations.
- b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews.
- c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.

1.6.7.1 Quality Manager Qualifications

The quality manager must hold a current license as a professional engineer in a U.S. state or territory with experience on at least five similar projects. Evidence of extraordinary proven experience may be considered by the Contracting Officer as sufficient to act as the Quality Manager.

1.6.7.2 Field Testing Technician and Testing Agency

Submit data on qualifications of proposed testing agency and technicians for approval by the Contracting Officer prior to performing testing on concrete.

- a. Work on concrete under this contract must be performed by an ACI Concrete Field Testing Technician Grade 1 qualified in accordance with ACI SP-2 or equivalent. Equivalent certification programs must include requirements for written and performance examinations as stipulated in ACI SP-2.
- b. Testing agencies that perform testing services on reinforcing steel must meet the requirements of ASTM E329.
- c. Testing agencies that perform testing services on concrete materials must meet the requirements of ASTM C1077.

1.6.8 Laboratory Qualifications for Concrete Qualification Testing

The concrete testing laboratory must have the necessary equipment and experience to accomplish required testing. The laboratory must meet the requirements of ASTM C1077 and be Cement and Concrete Reference Laboratory (CCRL) inspected.

1.6.9 Laboratory Accreditation

Laboratory and testing facilities must be provided by and at the expense of the Contractor. The laboratories performing the tests must be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation must be current and must include the required test methods, as specified. Furthermore, the testing must comply with the following requirements:

- a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies must be performed by an accredited laboratory

and under the direction of a registered professional engineer in a U.S. state or territory competent in concrete materials who is competent in concrete materials and must sign all reports and designs.

- b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M.
- c. Contractor Quality Control: All sampling and testing must be performed by an approved, onsite, independent, accredited laboratory.

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to material manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing period or for 72 hours after installation:

- a. Supply 100 percent outside air 24 hours a day.
- b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 84 degrees F and humidity is between 30 percent and 60 percent.
- c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.7.1 Submittals for Environmental Performance

- a. Provide data indication the percentage of post-industrial pozzolan (fly ash, slag cement) cement substitution as a percentage of the full product composite by weight.
- b. Provide data indicating the percentage of post-industrial and post-consumer recycled content aggregate.
- c. Provide product data indicating the percentage of post-consumer recycled steel content in each type of steel reinforcement as a percentage of the full product composite by weight.
- d. Provide product data stating the location where all products were manufactured
- e. For projects using FSC certified formwork, provide chain-of-custody documentation for all certified wood products.
- f. For projects using reusable formwork, provide data showing how formwork is reused.
- g. Provide SDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.
- h. Provide SDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low

volatile organic compound products.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

1.8.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 100 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING for cumulative total local material requirements. Concrete materials may be locally available. Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

1.8.2 Forest Stewardship Council (FSC) Certification

Use FSC-certified wood where specified. Provide letter of certification signed by lumber supplier. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers.

PART 2 PRODUCTS

2.1 FORMWORK MATERIALS

- a. Form-facing material in contact with concrete must be lumber, plywood, tempered concrete-form-grade hardboard, metal, plastic, or treated paper that creates specified appearance and texture of concrete surface. Submit product information on proposed form-facing materials if different from that specified herein.
- b. Design formwork, shores, reshores, and backshores to support loads transmitted to them and to comply with applicable building code requirements.
- c. Design formwork and shoring for load redistribution resulting from stressing of post-tensioned reinforcement. Ensure that formwork allows movement resulting from application of prestressing force.
- d. Design formwork to withstand pressure resulting from placement and vibration of concrete and to maintain specified tolerances.
- e. Design formwork to accommodate waterstop materials in joints at locations indicated in Contract Documents.
- f. Provide temporary openings in formwork if needed to facilitate cleaning and inspection.
- g. Design formwork joints to inhibit leakage of mortar.
- h. Limit deflection of facing materials for concrete surfaces exposed to view to 1/240 of center-to-center spacing of facing supports.
- i. Submit product information on proposed form-facing materials if different from that specified herein.

- j. Submit procedure for reshoring and backshoring, including drawings signed and sealed by a licensed design engineer. Include on shop drawings the formwork removal procedure and magnitude of construction loads used for design of reshoring or backshoring system. Indicate in procedure the magnitude of live and dead loads assumed for required capacity of the structure at time of reshoring or backshoring.
- k. Submit manufacturer's product data on form liner proposed for use with each formed surface.

2.1.1.1 Wood Forms

Use lumber as specified in Section 06 10 00 ROUGH CARPENTRY and as follows. Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with NIST PS 1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Submit data verifying that composite wood products contain no urea formaldehyde resins. Virgin wood used must be FSC-certified.

2.1.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.1.2 Carton Forms

Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete until initial set. Provide carton forms that contain a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content.

2.1.3 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORMWORK ACCESSORIES

- a. Use commercially manufactured formwork accessories, including ties and hangers.
- b. Form ties and accessories must not reduce the effective cover of the reinforcement.

2.2.1 Form Ties

- a. Use form ties with ends or end fasteners that can be removed without damage to concrete.
- b. Where indicated in Contract Documents, use form ties with integral water barrier plates or other acceptable positive water barriers in walls.

- c. The breakback distance for ferrous ties must be at least 3/4 in. for Surface Finish-2.0 or Surface Finish-3.0, as defined in ACI 301.
- d. Submit manufacturer's data sheet on form ties.

2.2.2 Waterstops

Submit manufacturer's data sheet on waterstop materials and splices.

2.2.2.1 PVC Waterstop

Polyvinylchloride waterstops must conform to COE CRD-C 572.

2.2.2.2 Rubber Waterstop

Rubber waterstops must conform to COE CRD-C 513.

2.2.2.3 Thermoplastic Elastomeric Rubber Waterstop

Thermoplastic elastomeric rubber waterstops must conform to ASTM D471.

2.2.2.4 Hydrophilic Waterstop

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water must conform to the following requirements when tested in accordance to ASTM D412: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness must be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F must be 3 to 1 minimum.

2.2.3 Biodegradable Form Release Agent

- a. Provide form release agent that is colorless, biodegradable, and water-based, with a low (maximum of 55 grams/liter (g/l)) VOC content.
- b. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
- c. Provide form release agent that reduces formwork moisture absorption, and does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene. Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.
- d. Submit manufacturer's product data on formwork release agent for use on each form-facing material.

2.2.4 Chamfer Materials

Use lumber materials with dimensions of 3/4 x 3/4 in.

2.2.5 Construction and movement joints

- a. Submit details and locations of construction joints in accordance with the requirements herein.
- b. Locate construction joints within middle one-third of spans of slabs,

beams, and girders. If a beam intersects a girder within the middle one-third of girder span, the distance between the construction joint in the girder and the edge of the beam must be at least twice the width of the larger member.

- c. Locate construction joints in walls and columns at underside of slabs, beams, or girders and at tops of footings or slabs.
- d. Make construction joints perpendicular to main reinforcement.
- e. Provide movement joints where indicated in Contract Documents or in accepted alternate locations.
- f. Submit location and detail of movement joints if different from those indicated in Contract Documents.
- g. Submit manufacturer's data sheet on expansion joint materials.
- h. Provide keyways where indicated in Contract Documents.

2.2.6 Perimeter Insulation

Perimeter insulation must be polystyrene conforming to ASTM C578, Type II; polyurethane conforming to ASTM C591, Type II; or cellular glass conforming to ASTM C552, Type I or IV. Comply with EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

2.2.7 Other Embedded items

Use sleeves, inserts, anchors, and other embedded items of material and design indicated in Contract Documents.

2.3 CONCRETE MATERIALS

2.3.1 Cementitious Materials

2.3.1.1 Portland Cement

- a. Unless otherwise specified, provide cement that conforms to ASTM C150/C150M Type II and meets low alkali content requirements.
- b. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.
- c. Supplier must certify that no hazardous waste is used in the fuel mix or raw materials.
- d. Submit information along with evidence demonstrating compliance with referenced standards. Submittals must include types of cementitious materials, manufacturing locations, shipping locations, and certificates showing compliance.
- e. Cementitious materials must be stored and kept dry and free from contaminants.

2.3.1.2 Blended Cements

- a. Blended cements must conform to ASTM C595/C595M Type IP(MS) or IS(MS) or ASTM C1157/C1157M Type MS.

- b. Slag cement added to the Type IS blend must meet ASTM C989/C989M.
- c. The pozzolan added to the Type IP blend must be ASTM C618 Class F fly ash and must be interground with the cement clinker. The manufacturer must state in writing that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot-to-lot or within a lot. The percentage and type of pozzolan used in the blend must not change from that submitted for the aggregate evaluation and mixture proportioning.

2.3.1.3 Fly Ash

- a. ASTM C618, Class F, except that the maximum allowable loss on ignition must not exceed 3 percent.
- b. Fly ash content must be a minimum of 15 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permissible that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759.

2.3.1.4 Slag cement

ASTM C989/C989M, Grade 100. Slag content must be a minimum of 25 percent by weight of cementitious material.

2.3.1.5 Other Supplementary Cementitious Materials

Natural pozzolan must be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling ASR and must have an ignition loss not exceeding 3 percent. Class N pozzolan for use in mitigating ASR must have a Calcium Oxide (CaO) content of less than 13 percent and total equivalent alkali content less than 3 percent.

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) must conform to ASTM C618, Class F or N, and the following additional requirements:

- a. The strength activity index at 28 days of age must be at least 95 percent of the control specimens.
- b. The average particle size must not exceed 6 microns.
- c. The sum of $\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$ must be greater than 77 percent.

2.3.2 Water

- a. Water or ice must comply with the requirements of ASTM C1602/C1602M.
- b. Minimize the amount of water in the mix. Improve workability by adjusting the grading of the aggregate and using admixture rather than by adding water.
- c. Water must be potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to

concrete.

- d. Protect mixing water and ice from contamination during storage and delivery.
- e. Submit test report showing water complies with ASTM C1602/C1602M.

2.3.3 Aggregate

2.3.3.1 Normal-Weight Aggregate

- a. Aggregates must conform to ASTM C33/C33M unless otherwise specified in the Contract Documents or approved by the contracting officer.
- b. Aggregates used in concrete must be obtained from the same sources and have the same size range as aggregates used in concrete represented by submitted field test records or used in trial mixtures.
- c. Provide sand that is at least 50 percent natural sand.
- d. Store and handle aggregate in a manner that will avoid segregation and prevents contamination by other materials or other sizes of aggregates. Store aggregates in locations that will permit them to drain freely. Do not use aggregates that contain frozen lumps.
- e. Submit types, pit or quarry locations, producers' names, aggregate supplier statement of compliance with ASTM C33/C33M, and ASTM C1293 expansion data not more than 18 months old.

2.3.3.2 Recycled Aggregate Materials

Use a minimum of 25 percent recycled aggregate, depending on local availability and conforming to requirements of the mix design. Recycled aggregate to include: recovered concrete and recovered stone that meets the aggregate requirements specified. Submit recycled material request with the aggregate certification submittals and do not use until approved by the Contracting Officer.

2.3.4 Admixtures

- a. Chemical admixtures must conform to ASTM C494/C494M.
- b. Air-entraining admixtures must conform to ASTM C260/C260M.
- c. Chemical admixtures for use in producing flowing concrete must conform to ASTM C1017/C1017M.
- d. Do not use calcium chloride admixtures.
- e. Use an ASR-inhibiting admixture for concrete containing aggregate susceptible to ASR.
- f. Admixtures used in concrete must be the same as those used in the concrete represented by submitted field test records or used in trial mixtures.
- g. Protect stored admixtures against contamination, evaporation, or damage.

- h. To ensure uniform distribution of constituents, provide agitating equipment for admixtures used in the form of suspensions or unstable solutions. Protect liquid admixtures from freezing and from temperature changes that would adversely affect their characteristics.
- i. Submit types, brand names, producers' names, manufacturer's technical data sheets, and certificates showing compliance with standards required herein.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Concrete Curing Materials

Provide concrete curing material in accordance with ACI 301 Section 5 and ACI 308.1 Section 2. Submit product data for concrete curing compounds. Submit manufactures instructions for placement of curing compound.

2.4.2 Nonshrink Grout

Nonshrink grout in accordance with ASTM C1107/C1107M.

2.4.3 Expansion/Contraction Joint Filler

ASTM D1751 or ASTM D1752 Type I or Type II. Material must be 1/2 inch thick, unless otherwise indicated.

2.4.4 Joint Sealants

Submit manufacturer's product data, indicating VOC content.

2.4.4.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D6690 or ASTM C920, Type M, Class 25, Use T.

2.4.4.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C920, Type M, Grade NS, Class 25, Use T.

2.4.4.3 Preformed Polychloroprene Elastomeric Type

ASTM D2628.

2.4.4.4 Lubricant for Preformed Compression Seals

ASTM D2835.

2.4.5 Vapor Barrier

ASTM E1745 Class A polyethylene sheeting, minimum 20 mil thickness or other equivalent material with a maximum permeance rating of 0.01 perms per ASTM E96/E96M. Vapor barrier must be resistant to gasoline, oils, solvents, hydrocarbons, radon, and methane. Materials shall have a maximum water vapor transmission rate of 0.004 grains/hr-sqft per ASTM E96/E96M. All edges of penetrations through and transitions in the vapor varrier to be sealed.

Consider plastic vapor barrier and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

2.4.6 Dovetail Anchor Slot

Preformed metal slot approximately 1 inch by 1 inch of not less than 22 gage galvanized steel cast in concrete. Coordinate actual size and throat opening with dovetail anchors and provide with removable filler material.

2.5 CONCRETE MIX DESIGN

2.5.1 Properties and Requirements

- a. Use materials and material combinations listed in this section and the contract documents.
- b. Cementitious material content must be adequate for concrete to satisfy the specified requirements for strength, w/cm, durability, and finishability described in this section and the contract documents.

The minimum cementitious material content for concrete used in floors must meet the following requirements:

Nominal maximum size of aggregate, in.	Minimum cementitious material content, pounds per cubic yard
1-1/2	470
1	520
3/4	540
3/8	610

- c. Selected target slump must meet the requirements this section, the contract documents, and must not exceed 9 in. Concrete must not show visible signs of segregation.
- d. The target slump must be enforced for the duration of the project. Determine the slump by ASTM C143/C143M. Slump tolerances must meet the requirements of ACI 117.
- e. The nominal maximum size of coarse aggregate for a mixture must not exceed three-fourths of the minimum clear spacing between reinforcement, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.
- f. Concrete must be air entrained for members assigned to Exposure Class F1, F2, or F3. The total air content must be in accordance with the requirements of the paragraph titled DURABILITY.
- g. Measure air content at the point of delivery in accordance with ASTM C173/C173M or ASTM C231/C231M.
- h. Concrete for slabs to receive a hard-troweled finish must not contain an air-entraining admixture or have a total air content greater than 3 percent.
- i. Concrete properties and requirements for each portion of the structure

are specified in the table below. Refer to the paragraph titled DURABILITY for more details on exposure categories and their requirements.

	Minimum $f'c$ psi	Exposure Categories^	Miscellaneous Requirements
Footings	5000t 28 days	S1 ; C0 ; W0 ; F2	Nominal maximum aggregate size must be 3/4 in.
Foundation walls	5000 at 28 days	S1 ; C0 ; W0 ; F3	Nominal maximum aggregate size must be 3/4 in.
Elevated slabs	4000t 28 days	S1 ; C0 ; W0 ; F0	Nominal maximum aggregate size must be 1/2 in.
Slabs-on-ground	5000t 28 days	S1 ; C0 ; W0 ; F2	

2.5.2 Durability

2.5.2.1 Alkali-Aggregate Reaction

Do not use any aggregate susceptible to alkali-carbonate reaction (ACR). Use one of the three options below for qualifying concrete mixtures to reduce the potential of alkali-silica reaction (ASR):

- For each aggregate used in concrete, the expansion result determined in accordance with ASTM C1293 must not exceed 0.04 percent at one year.
- For each aggregate used in concrete, the expansion result of the aggregate and cementitious materials combination determined in accordance with ASTM C1567 must not exceed 0.10 percent at an age of 16 days.
- Alkali content in concrete (LBA) must not exceed 4 pounds per cubic yard for moderately reactive aggregate or 3 pounds per cubic yard for highly reactive aggregate. Reactivity must be determined by testing in accordance with ASTM C1293 and categorized in accordance with ASTM C1778. Alkali content is calculated as follows:

$$LBA = (\text{cement content, pounds per cubic yard}) \times (\text{equivalent alkali content of portland cement in percent}/100 \text{ percent})$$

2.5.2.2 Freezing and Thawing Resistance

- Provide concrete meeting the following requirements based on exposure class assigned to members for freezing-and-thawing exposure in Contract Documents:

Exposure class	Maximum w/cm^*	Minimum $f'c$, psi	Air content	Additional Requirements
F0	N/A	2500	N/A	
F1	0.55	3500	Depends on aggregate size	N/A
F2	0.45	4500	Depends on aggregate size	See limits on maximum cementitious material by mass
F3	0.40	5000	Depends on aggregate size	See limits on maximum cementitious material by mass
F3 plain concrete	0.45	4500	Depends on aggregate size	See limits on maximum cementitious material by mass

*The maximum w/cm limits do not apply to lightweight concrete.

- b. Concrete must be air entrained for members assigned to Exposure Class F1, F2, or F3. The total air content must meet the requirements of the following table:

Nominal maximum aggregate size, in.	Total air content, percent [^]	
	Exposure Class F2 and F3	Exposure Class F1
3/8	7.5	6.0
1/2	7.0	5.5
3/4	6.0	5.0
1	6.0	4.5
1-1/2	5.5	4.5
2	5.0	4.0
3	5.5	3.5

*Tolerance on air content as delivered must be plus/minus 1.5 percent.

[^]For $f'c$ greater than 5000 psi, reducing air content by 1.0 percentage point is acceptable.

- c. Submit documentation verifying compliance with specified requirements.
- d. For sections of the structure that are assigned Exposure Class F3, submit certification on cement composition verifying that concrete

mixture meets the requirements of the following table:

Cementitious material	Maximum percent of total cementitious material by mass*
Fly ash or other pozzolans conforming to ASTM C618	25
Slag cement conforming to ASTM C989/C989M	50
Total of fly ash or other pozzolans and slag cement	50^
Total of fly ash or other pozzolans	35^

*Total cementitious material also includes ASTM C150/C150M, ASTM C595/C595M, ASTM C845/C845M, and ASTM C1157/C1157M cement. The maximum percentages above must include:

- i. Fly ash or other pozzolans present in ASTM C1157/C1157M or ASTM C595/C595M Type IP blended cement.
 - ii. Slag cement present in ASTM C1157/C1157M or ASTM C595/C595M Type IS blended cement.
 - iii. Silica fume conforming to ASTM C1240 present in ASTM C1157/C1157M or ASTM C595/C595M Type IP blended cement.
- ^Fly ash or other pozzolans and silica fume must constitute no more than 25 percent and 10 percent, respectively, of the total mass of the cementitious materials.

2.5.2.3 Corrosion and Chloride Content

- a. Provide concrete meeting the requirements of the following table based on the exposure class assigned to members requiring protection against reinforcement corrosion in Contract Documents.
- b. Submit documentation verifying compliance with specified requirements.
- c. Water-soluble chloride ion content contributed from constituents including water, aggregates, cementitious materials, and admixtures must be determined for the concrete mixture by ASTM C1218/C1218M at age between 28 and 42 days.
- d. The maximum water-soluble chloride ion (Cl-) content in concrete, percent by mass of cement is as follows:

Exposure class	Maximum w/cm*	Minimum f'c, psi	Maximum water-soluble chloride ion (CL-) content in concrete, percent by mass of cement
Reinforced concrete			
C0	N/A	2500	1.00
C1	N/A	2500	0.30
C2	0.4	5000	0.15

Exposure class	Maximum w/cm*	Minimum f'c, psi	Maximum water-soluble chloride ion (CL-) content in concrete, percent by mass of cement
Prestressed concrete			
C0	N/A	2500	0.06
C1	N/A	2500	0.06
C2	0.4	5000	0.06

*The maximum w/cm limits do not apply to lightweight concrete.

2.5.2.4 Sulfate Resistance

- a. Provide concrete meeting the requirements of the following table based on the exposure class assigned to members for sulfate exposure.

Exposure class	Maximum w/cm	Minimum f'c, psi	Required cementitious materials-types			Calcium chloride admixture
			ASTM	ASTM	ASTM	
S0	N/A	2500	N/A	N/A	N/A	No
S1	0.50	4000	II [^]	IP(MS); IS(<70)(MS); IT(MS)	MS	No restrictions
S2	0.45	4500	IV [^]	IP(HS); IS(<70)(HS); IT(HS)	HS	Not permitted
S3	0.45	4500	V + pozzolan or slag cement**	IP(HS)+ pozzolan or slag cement [^] ; IS (<70)(HS) + pozzolan or slag cement [^] ; IT (HS) + pozzolan or slag cement**	HS + pozzolan or slag cement**	Not permitted

* For seawater exposure, other types of portland cements with tricalcium aluminate (C3A) contents up to 10 percent are acceptable if the w/cm does not exceed 0.40.

** The amount of the specific source of the pozzolan or slag cement to be used shall be at least the amount determined by test or service record to improve sulfate resistance when used in concrete containing Type V cement. Alternatively, the amount of the specific source of the pozzolan or slag used shall not be less than the amount tested in accordance with ASTM C1012/C1012M and meeting the requirements maximum expansion requirements listed herein.

^ Other available types of cement, such as Type III or Type I, are acceptable in exposure classes S1 or S2 if the C3A contents are less than 8 or 5 percent, respectively.

- b. The maximum w/cm limits for sulfate exposure do not apply to lightweight concrete.
- c. Alternative combinations of cementitious materials of those listed in this paragraph are acceptable if they meet the maximum expansion requirements listed in the following table:

Exposure class	Maximum expansion when tested using ASTM C1012/C1012M		
	At 6 months	At 6 months	At 18 months
S1	0.10 percent	N/A	N/A
S2	0.05 percent	0.10 percent^	N/A
S3	N/A	N/A	0.10 percent

^The 12-month expansion limit applies only when the measured expansion exceeds the 6-month maximum expansion limit.

2.5.2.5 Concrete Temperature

The temperature of concrete as delivered must not exceed 95°F.

2.5.2.6 Concrete permeability

- a. Provide concrete meeting the requirements of the following table based on exposure class assigned to members requiring low permeability in the Contract Documents.

Exposure class	Maximum w/cm*	Minimum f'c, psi	Additional minimum requirements
W0	N/A	2500	None
W1	0.5	4000	None

*The maximum w/cm limits do not apply to lightweight concrete.

- b. Submit documentation verifying compliance with specified requirements.

2.5.3 Trial Mixtures

Trial mixtures must be in accordance to ACI 301.

2.5.4 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C94/C94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the

following information in addition to that required by ASTM C94/C94M:

- a. Type and brand cement
- b. Cement and supplementary cementitious materials content in 94-pound bags per cubic yard of concrete
- c. Maximum size of aggregate
- d. Amount and brand name of admixtures
- e. Total water content expressed by water cementitious material ratio

2.6 REINFORCEMENT

- a. Bend reinforcement cold. Fabricate reinforcement in accordance with fabricating tolerances of ACI 117.
- b. Submit manufacturer's certified test report for reinforcement.
- c. Submit placing drawings showing fabrication dimensions and placement locations of reinforcement and reinforcement supports. Placing drawings must indicate locations of splices, lengths of lap splices, and details of mechanical and welded splices.
- d. Submit request with locations and details of splices not indicated in Contract Documents.
- e. Submit request to place column dowels without using templates.
- f. Submit request for field cutting, including location and type of bar to be cut and reason field cutting is required.

2.6.1 Reinforcing Bars

- a. Reinforcing bars must be deformed, except spirals, load-transfer dowels, and welded wire reinforcement, which may be plain.
- b. ASTM A615/A615M with the bars marked S, Grade 60. See Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING for cumulative total recycled content requirements.
- c. Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.
- d. Submit mill certificates for reinforcing bars.

2.6.2 Wire

- a. See Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING for cumulative total recycled content requirements. Wire reinforcement may contain post-consumer or post-industrial recycled content. Provide flat sheets of welded wire reinforcement for slabs and toppings.
- b. Plain or deformed steel wire must conform to ASTM A1064/A1064M.

- c. Stainless steel wire must conform to ASTM A1022/A1022M.

2.6.3 Welded wire reinforcement

- a. Use welded wire reinforcement specified in Contract Documents and conforming to one or more of the specifications given herein.
- b. Plain welded wire reinforcement must conform to ASTM A1064/A1064M, with welded intersections spaced no greater than 12 in. apart in direction of principal reinforcement.
- c. Deformed welded wire reinforcement must conform to ASTM A1064/A1064M, with welded intersections spaced no greater than 16 in. apart in direction of principal reinforcement.

2.6.4 Reinforcing Bar Supports

- a. Provide reinforcement support types within structure as required by Contract Documents. Reinforcement supports must conform to CRSI RB4.1. Submit description of reinforcement supports and materials for fastening coated reinforcement if not in conformance with CRSI RB4.1.
- b. Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.
- c. See Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING for cumulative total recycled content requirements. Plastic and steel may contain post-consumer or post-industrial recycled content.

2.6.5 Dowels for Load Transfer in Floors

Provide greased dowels for load transfer in floors of the type, design, weight, and dimensions indicated. Provide dowel bars that are plain-billet steel conforming to ASTM A615/A615M, Grade 40. Provide dowel pipe that is steel conforming to ASTM A53/A53M.

2.6.6 Welding

- a. Provide weldable reinforcing bars that conform to ASTM A706/A706M and ASTM A615/A615M and Supplement S1, Grade 60, except that the maximum carbon content must be 0.55 percent.
- b. Comply with AWS D1.4/D1.4M unless otherwise specified. Do not tack weld reinforcing bars.
- c. Welded assemblies of steel reinforcement produced under factory conditions, such as welded wire reinforcement, bar mats, and deformed bar anchors, are allowed.
- d. After completing welds on zinc-coated (galvanized), epoxy-coated, or zinc and epoxy dual-coated reinforcement, coat welds and repair coating damage as previously specified.

PART 3 EXECUTION

3.1 EXAMINATION

- a. Do not begin installation until substrates have been properly constructed; verify that substrates are level.

- b. If substrate preparation is the responsibility of another installer, notify Contracting Officer of unsatisfactory preparation before processing.
- c. Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Contracting Officer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

- a. Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.
- b. Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

- a. When subgrade material is semi-porous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited, or seal subgrade surface by covering surface with specified vapor barrier.
- b. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor barrier.

3.2.3 Subgrade Under Slabs on Ground

- a. Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.
- b. Previously constructed subgrade or fill must be cleaned of foreign materials
- c. Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.
- d. Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

3.2.4 Edge Forms and Screed Strips for Slabs

- a. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment.

- b. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.5 Reinforcement and Other Embedded Items

- a. Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.
- b. When concrete is placed, reinforcement must be free of materials deleterious to bond. Reinforcement with rust, mill scale, or a combination of both will be considered satisfactory, provided minimum nominal dimensions, nominal weight, and minimum average height of deformations of a hand-wire-brushed test specimen are not less than applicable ASTM specification requirements.

3.3 FORMS

- a. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade.
- b. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch. Place chamfer strips in corners of formwork to produce beveled edges on permanently exposed surfaces. Do not bevel reentrant corners or edges of formed joints of concrete.
- c. Provide formwork with clean-out openings to permit inspection and removal of debris.
- d. Inspect formwork and remove foreign material before concrete is placed.
- e. At construction joints, lap form-facing materials over the concrete of previous placement. Ensure formwork is placed against hardened concrete so offsets at construction joints conform to specified tolerances.
- f. Provide positive means of adjustment (such as wedges or jacks) of shores and struts. Do not make adjustments in formwork after concrete has reached initial setting. Brace formwork to resist lateral deflection and lateral instability.
- g. Fasten form wedges in place after final adjustment of forms and before concrete placement.
- h. Provide anchoring and bracing to control upward and lateral movement of formwork system.
- i. Construct formwork for openings to facilitate removal and to produce opening dimensions as specified and within tolerances.
- j. Provide runways for moving equipment. Support runways directly on formwork or structural members. Do not support runways on reinforcement. Loading applied by runways must not exceed capacity of formwork or structural members.
- k. Position and support expansion joint materials, waterstops, and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with removable material to prevent concrete entry into voids.

1. Clean surfaces of formwork and embedded materials of mortar, grout, and foreign materials before concrete placement.

3.3.1 Coating

- a. Cover formwork surfaces with an acceptable material that inhibits bond with concrete.
- b. If formwork release agent is used, apply to formwork surfaces in accordance with manufacturer's recommendations before placing reinforcement. Remove excess release agent on formwork prior to concrete placement.
- c. Do not allow formwork release agent to contact reinforcement or hardened concrete against which fresh concrete is to be placed.

3.3.2 Reshoring

- a. Do not allow structural members to be loaded with combined dead and construction loads in excess of loads indicated in the accepted procedure.
- b. Install and remove reshores or backshores in accordance with accepted procedure.
- c. For floors supporting shores under newly placed concrete, either leave original supporting shores in place, or install reshores or backshores. Shoring system and supporting slabs must resist anticipated loads. Locate reshores and backshores directly under a shore position or as indicated on formwork shop drawings.
- d. In multistory buildings, place reshoring or backshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms, and construction live loads.

3.3.3 Reuse

- a. Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.
- b. Wood forms must not be clogged with paste and must be capable of absorbing high water-cementitious material ratio paste.
- c. Remove leaked mortar from formwork joints before reuse.

3.3.4 Forms for Standard Rough Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-1.0, for formed surfaces that are to be concealed by other construction.

3.3.5 Forms for Standard Smooth Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-3.0, for formed surfaces that are exposed to view. Do not provide mockup of concrete surface appearance and texture.

3.3.6 Form Ties

- a. For post-tensioned structures, do not remove formwork supports until stressing records have been accepted by the Contracting Officer.
- b. After ends or end fasteners of form ties have been removed, repair tie holes in accordance with ACI 301 Section 5 requirements.

3.3.7 Tolerances for Form Construction

- a. Construct formwork so concrete surfaces conform to tolerances in ACI 117.
- b. Position and secure sleeves, inserts, anchors, and other embedded items such that embedded items are positioned within ACI 117 tolerances.
- c. To maintain specified elevation and thickness within tolerances, install formwork to compensate for deflection and anticipated settlement in formwork during concrete placement. Set formwork and intermediate screed strips for slabs to produce designated elevation, camber, and contour of finished surface before formwork removal. If specified finish requires use of vibrating screeds or roller pipe screeds, ensure that edge forms and screed strips are strong enough to support such equipment.

3.3.8 Removal of Forms and Supports

- a. If vertical formed surfaces require finishing, remove forms as soon as removal operations will not damage concrete.
- b. Remove top forms on sloping surfaces of concrete as soon as removal will not allow concrete to sag. Perform repairs and finishing operations required. If forms are removed before end of specified curing period, provide curing and protection.
- c. Do not damage concrete during removal of vertical formwork for columns, walls, and sides of beams. Perform needed repair and finishing operations required on vertical surfaces. If forms are removed before end of specified curing period, provide curing and protection.
- d. Form-facing material and horizontal facing support members may be removed before in-place concrete reaches specified compressive strength if shores and other supports are designed to allow facing removal without deflection of supported slab or member.

3.3.9 Strength of Concrete Required for Removal of Formwork

If removal of formwork, reshoring, or backshoring is based on concrete reaching a specified in-place strength, mold and field-cure cylinders in accordance with ASTM C31/C31M. Test cylinders in accordance with ASTM C39/C39M. Alternatively, use one or more of the methods listed herein to evaluate in-place concrete strength for formwork removal.

- a. Tests of cast-in-place cylinders in accordance with ASTM C873/C873M. This option is limited to slabs with concrete depths from 5 to 12 in.
- b. Penetration resistance in accordance with ASTM C803/C803M.

- c. Pullout strength in accordance with ASTM C900.
- d. Maturity method in accordance with ASTM C1074. Submit maturity method data using project materials and concrete mix proportions used on the project to demonstrate the correlation between maturity and compressive strength of laboratory cured test specimens to the Contracting Officer.

3.4 WATERSTOP INSTALLATION AND SPLICES

- a. Provide waterstops in construction joints as indicated.
- b. Install formwork to accommodate waterstop materials. Locate waterstops in joints where indicated in Contract Documents. Minimize number of splices in waterstop. Splice waterstops in accordance with manufacturer's written instructions. Install factory-manufactured premolded mitered corners.
- c. Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Protect waterstops protruding from joints from damage.

3.4.1 PVC Waterstop

Make splices by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. Reform waterstops at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled, must show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.4.2 Rubber Waterstop

Rubber waterstops must be spliced using cold bond adhesive as recommended by the manufacturer.

3.4.3 Thermoplastic Elastomeric Rubber Waterstop

Fittings must be shop made using a machine specifically designed to mechanically weld the waterstop. A portable power saw must be used to miter or straight cut the ends to be joined to ensure good alignment and contact between joined surfaces. Maintain continuity of the characteristic features of the cross section of the waterstop (for example ribs, tabular center axis, and protrusions) across the splice.

3.4.4 Hydrophilic Waterstop

Miter cut ends to be joined with sharp knife or shears. The ends must be adhered with adhesive.

3.5 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

- a. Unless otherwise specified, placing reinforcement and miscellaneous materials must be in accordance to ACI 301. Provide bars, welded wire reinforcement, wire ties, supports, and other devices necessary to install and secure reinforcement.

- b. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.
- c. Nonprestressed cast-in-place concrete members must have concrete cover for reinforcement given in the following table:

Concrete Exposure	Member	Reinforcement	Specified cover, in.
Cast against and permanently in contact with ground	All	All	3
Exposed to weather or in contact with ground	All	No. 6 through No. 18 bars	2
		No. 5 bar, W31 or D31 wire, and smaller	1-1/2
Not exposed to weather or in contact with ground	Slabs, joists, and walls	No. 14 and No. 18 bars	1-1/2
		No. 11 bar and smaller	3/4
	Beams, columns, pedestals, and tension ties	Primary reinforcement, stirrups, ties, spirals, and hoops	1-1/2

3.5.1 General

Provide details of reinforcement that are in accordance with the Contract Documents.

3.5.2 Vapor Barrier

- a. Install in accordance with ASTM E1643. Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches and tape.
- b. Remove torn, punctured, or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete. Concrete placement must not damage vapor barrier material. Place a 2 inch layer of

clean concrete sand on vapor barrier before placing concrete.

3.5.3 Perimeter Insulation

Install perimeter insulation at locations indicated. Adhesive must be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.5.4 Reinforcement Supports

Provide reinforcement support in accordance with CRSI RB4.1 and ACI 301 Section 3 requirements. Supports for coated or galvanized bars must also be coated with electrically compatible material for a distance of at least 2 inches beyond the point of contact with the bars.

3.5.5 Splicing

As indicated in the Contract Documents. For splices not indicated follow ACI 301. Do not splice at points of maximum stress. Overlap welded wire reinforcement the spacing of the cross wires, plus 2 inches.

3.5.6 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement and support against displacement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.5.7 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

- a. Provide fabrication tolerances that are in accordance with ACI 117.
- b. Provide hooks and bends that are in accordance with the Contract Documents.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

- a. Bar lengths, depths, and bends beyond specified fabrication tolerances
- b. Bends or kinks not indicated on drawings or approved shop drawings
- c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.5.8 Placing Reinforcement

Place reinforcement in accordance with ACI 301.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire reinforcement on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

- a. Provide supports for reinforcing bars that are sufficient in number and have sufficient strength to carry the reinforcement they support, and in accordance with ACI 301 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.
- b. Equip supports on ground and similar surfaces with sand-plates.
- c. Support welded wire reinforcement as required for reinforcing bars.
- d. Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.
- e. Reinforcement must be accurately placed, securely tied at intersections, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to the Contract Documents.
- f. Bending of reinforcing bars partially embedded in concrete is permitted only as specified in the Contract Documents.

3.5.9 Spacing of Reinforcing Bars

- a. Spacing must be as indicated in the Contract Documents.
- b. Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to preapproval by the Contracting Officer.

3.5.10 Concrete Protection for Reinforcement

Additional concrete protection must be in accordance with the Contract Documents.

3.5.11 Welding

Welding must be in accordance with AWS D1.4/D1.4M.

3.6 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

In accordance with ASTM C94/C94M, ACI 301, ACI 302.1R and ACI 304R, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.6.1 Measuring

Make measurements at intervals as specified in paragraphs SAMPLING and TESTING.

3.6.2 Mixing

- a. Mix concrete in accordance with ASTM C94/C94M, ACI 301 and ACI 304R.
- b. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F.
- c. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and submitted water-cementitious material ratio are not exceeded and the required concrete strength is still met. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required.
- d. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch. Do not reconstitute concrete that has begun to solidify.

3.6.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.7 PLACING CONCRETE

Place concrete in accordance with ACI 301 Section 5.

3.7.1 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must

be a minimum of 4 inches greater than indicated.

3.7.2 Pumping

ACI 304R and ACI 304.2R. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches at discharge/placement. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of coarse aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well-rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.7.3 Cold Weather

Cold weather concrete must meet the requirements of ACI 301 unless otherwise specified. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 37 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.7.4 Hot Weather

Hot weather concrete must meet the requirements of ACI 301 unless otherwise specified. Maintain required concrete temperature using Figure 4.2 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.7.5 Bonding

Surfaces of set concrete at joints, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

- a. At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of

fresh concrete.

- b. At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.
- c. Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

3.8 WASTE MANAGEMENT

Provide as specified in the Waste Management Plan and as follows.

3.8.1 Mixing Equipment

Before concrete pours, designate Contractor-owned site meeting environmental standards for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.8.2 Hardened, Cured Waste Concrete

Crush and reuse hardened, cured waste concrete as fill or as a base course for pavement.

3.8.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.8.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material. Return excess cement to supplier. Institute deconstruction and construction waste separation and recycling for use in manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.

3.9 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

In accordance with ACI 301 and ACI 302.1R, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Depress the concrete base slab where indicated. Where straightedge measurements are specified, Contractor must provide straightedge.

3.9.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.9.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. Finish concrete in accordance with ACI 301 Section 5 for a scratched finish.

3.9.1.2 Steel Troweled

Use for floors intended as walking surfaces and for reception of floor coverings. Finish concrete in accordance with ACI 301 Section 5 for a steel troweled finish.

3.9.1.3 Nonslip Finish

Use on surfaces of exterior platforms, steps, and landings; and on exterior and interior pedestrian ramps. Finish concrete in accordance with ACI 301 Section 5 for a dry-shake finish. After the selected material has been embedded by the two floatings, complete the operation with a broomed finish.

3.9.1.4 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Finish concrete in accordance with ACI 301 Section 5 for a broomed finish.

3.9.1.5 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by a burlap drag. Drag a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8 inch.

3.9.2 Flat Floor Finishes

ACI 302.1R. Construct in accordance with one of the methods recommended in Table 7.15.3, "Typical Composite Ff/FL Values for Various Construction Methods." ACI 117 for tolerance tested by ASTM E1155.

a. Specified Industrial:

Floor Flatness (Ff) 30 20 minimum
Floor Levelness (FL) 20 13 minimum

3.9.2.1 Measurement of Floor Tolerances

Test slab within 24 hours of the final troweling. Provide tests to Contracting Officer within 12 hours after collecting the data. Floor flatness inspector is required to provide a tolerance report which must include:

- a. Key plan showing location of data collected.
- b. Results required by ASTM E1155.

3.9.2.2 Remedies for Out of Tolerance Work

Contractor is required to repair and retest any floors not meeting specified tolerances. Prior to repair, Contractor must submit and receive approval for the proposed repair, including product data from any materials proposed. Repairs must not result in damage to structural integrity of the floor. For floors exposed to public view, repairs must prevent any uneven or unusual coloring of the surface.

3.9.3 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints 1 inch deep, or one fourth the slab thickness whichever is deeper, with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.9.4 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.9.5 Curbs

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.9.6 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and must be 24 inches long, 12 inches wide and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

3.10 JOINTS

3.10.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Joints must be perpendicular to main reinforcement. Reinforcement must be continued and developed across construction joints. Locate construction joints as follows:

3.10.1.1 Maximum Allowable Construction Joint Spacing

- a. In walls at not more than 60 feet in any horizontal direction.
- b. In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet.

3.10.1.2 Construction Joints for Constructability Purposes

- a. In walls, at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall.
- b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier.
- c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

3.10.2 Isolation Joints in Slabs on Ground

- a. Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
- b. Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.10.3 Contraction Joints in Slabs on Ground

- a. Provide joints to form panels as indicated.
- b. Under and on exact line of each control joint, cut 50 percent of welded wire reinforcement before placing concrete.
- c. Sawcut contraction joints into slab on ground in accordance with ACI 301 Section 5.
- d. Sawcutting will be limited to within 12 hours after set and at 1/4 slab depth.

3.10.4 Sealing Joints in Slabs on Ground

- a. Contraction and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.
- b. Sealed groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.11 CURING AND PROTECTION

Curing and protection in accordance with ACI 301 Section 5, unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer, hardener, or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.11.1 Curing Periods

ACI 301 Section 5, except 10 days for retaining walls, pavement or chimneys. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

3.11.2 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.11.3 Curing Unformed Surfaces

- a. Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.
- b. Accomplish final curing of unformed surfaces by any of curing methods specified, as applicable.

3.11.4 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during

other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

3.11.5 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.11.6 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

ASTM C172/C172M. Collect samples of fresh concrete to perform tests specified. ASTM C31/C31M for making test specimens.

3.12.2 Testing

3.12.2.1 Slump Tests

ASTM C143/C143M. Take concrete samples during concrete placement/discharge. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cementitious material ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.12.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.12.2.3 Compressive Strength Tests

ASTM C39/C39M. Make six 6 inch by 12 inch test cylinders for each set of tests in accordance with ASTM C31/C31M, ASTM C172/C172M and applicable requirements of ACI 305R and ACI 306R. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold two cylinder in reserve. Take samples for strength tests of each mix design of concrete placed each day not less than once a day, nor less than once for each 100 cubic yards of concrete for the first 500 cubic yards, then every 500 cubic yards thereafter, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders

from the same concrete sample tested at 28 days. Concrete compressive tests must meet the requirements of this section, the Contract Document, and ACI 301. Retest locations represented by erratic core strengths. Where retest does not meet concrete compressive strength requirements submit a mitigation or remediation plan for review and approval by the contracting officer. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.12.2.4 Air Content

ASTM C173/C173M or ASTM C231/C231M for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.12.2.5 Strength of Concrete Structure

The strength of the concrete structure will be considered to be deficient if any of the following conditions are identified:

- a. Failure to meet compressive strength tests as evaluated.
- b. Reinforcement not conforming to requirements specified.
- c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
- d. Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified.
- e. Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration.
- f. Poor workmanship likely to result in deficient strength.

Where the strength of the concrete structure is considered deficient submit a mitigation or remediation plan for review and approval by the contracting officer.

3.12.2.6 Non-Conforming Materials

Factors that indicate that there are non-conforming materials include (but not limited to) excessive compressive strength, inadequate compressive strength, excessive slump, excessive voids and honeycombing, concrete delivery records that indicate excessive time between mixing and placement, or excessive water was added to the mixture during delivery and placement. Any of these indicators alone are sufficient reason for the Contracting Officer to request additional sampling and testing.

Investigations into non-conforming materials must be conducted at the Contractor's expense. The Contractor must be responsible for the investigation and must make written recommendations to adequately mitigate or remediate the non-conforming material. The Contracting Officer may accept, accept with reduced payment, require mitigation, or require removal and replacement of non-conforming material at no additional cost to the Government.

3.12.2.7 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does

not meet specification requirements or there are non-conforming materials, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C42/C42M, and as follows:

- a. Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.
- b. Test cores after moisture conditioning in accordance with ASTM C42/C42M if concrete they represent is more than superficially wet under service.
- c. Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.
- d. Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

3.13 REPAIR, REHABILITATION AND REMOVAL

Before the Contracting Officer accepts the structure the Contractor must inspect the structure for cracks, damage and substandard concrete placements that may adversely affect the service life of the structure. A report documenting these defects must be prepared which includes recommendations for repair, removal or remediation must be submitted to the Contracting Officer for approval before any corrective work is accomplished.

3.13.1 Crack Repair

Prior to final acceptance, all cracks in excess of 0.02 inches wide must be documented and repaired. The proposed method and materials to repair the cracks must be submitted to the Contracting Officer for approval. The proposal must address the amount of movement expected in the crack due to temperature changes and loading.

3.13.2 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Concrete surfaces with weak surfaces less than 1/4 inch thick must be diamond ground to remove the weak surface. Surfaces containing weak surfaces greater than 1/4 inch thick must be removed and replaced or mitigated in a manner acceptable to the Contracting Officer.

3.13.3 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor must be approved by the Contracting Officer prior to proceeding.

-- End of Section --

SECTION 03 31 30

MARINE CONCRETE

02/19

PART 1 GENERAL

1.1 SCOPE OF WORK

This section applies to cast-in-place concrete for the pier, trestle, bulkhead, and floating dock, including but not limited to:

- a. Bulkhead, trestle, floating dock, and pier pipe pile plugs/fill;
- b. Drilled shaft concrete;
- c. Bulkhead fascia;
- d. Bulkhead, trestle, and pier pile caps;
- e. Trestle approach slab;
- f. Trestle and pier topping slabs;
- g. Trestle edge beams and vehicle barrier; and
- h. Trestle and pier lightpole foundations;
- i. Pier utility trench;
- j. Pier bollard foundations;
- k. Pier bull rail/curb; and
- l. Pier substation platform walls.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

- | | |
|--------------|---|
| AASHTO M 182 | (2005; R 2017) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats |
| AASHTO R 80 | (2017) Standard Practice for Determining the Reactivity of Concrete Aggregates and Selecting Appropriate Measures for Preventing Deleterious Expansion in New Concrete Construction |
| AASHTO T 358 | (2017) Standard Method of Test for Surface Resistivity Indication of Concrete's Ability to Resist Chloride Ion Penetration |

AMERICAN CONCRETE INSTITUTE (ACI)

- | | |
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| ACI 117 | (2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary |
| ACI 121R | (2008) Guide for Concrete Construction Quality Systems in Conformance with ISO 9001 |

ACI 201.2R	(2016) Guide to Durable Concrete
ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 214R	(2011) Evaluation of Strength Test Results of Concrete
ACI 301	(2016) Specifications for Structural Concrete
ACI 304.2R	(2017) Guide to Placing Concrete by Pumping Methods
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2020) Guide to Hot Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting
ACI 308.1	(2011) Specification for Curing Concrete
ACI 309R	(2005) Guide for Consolidation of Concrete
ACI 311.4R	(2005) Guide for Concrete Inspection
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
ACI 347R	(2014; Errata 1 2017) Guide to Formwork for Concrete
ACI SP-2	(2007; Abstract: 10th Edition) ACI Manual of Concrete Inspection
ACI SP-15	(2011) Field Reference Manual: Standard Specifications for Structural Concrete ACI 301-05 with Selected ACI References
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2018) Structural Welding Code - Reinforcing Steel
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APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA PS 1	(2009) Structural Plywood (with Typical APA Trademarks)
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ASTM INTERNATIONAL (ASTM)

ASTM A706/A706M	(2016) Standard Specification for
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	Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2019) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A934/A934M	(2016) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A970/A970M	(2018) Standard Specification for Headed Steel Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2018a) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2021a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2020) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C78/C78M	(2021) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM C138/C138M	(2017a) Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2021) Standard Specification for Portland Cement
ASTM C157/C157M	(2017) Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
ASTM C171	(2020) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete

ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	(2019) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C294	(2012; R 2017) Standard Descriptive Nomenclature for Constituents of Concrete Aggregates
ASTM C295/C295M	(2019) Standard Guide for Petrographic Examination of Aggregates for Concrete
ASTM C311/C311M	(2018) Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C457/C457M	(2016) Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C595/C595M	(2021) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C666/C666M	(2015) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C805/C805M	(2018) Standard Test Method for Rebound Number of Hardened Concrete
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1017/C1017M	(2013; E 2015) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064/C1064M	(2017) Standard Test Method for Temperature of Freshly Mixed

Hydraulic-Cement Concrete

ASTM C1077	(2017) Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1116/C1116M	(2010a; R 2015) Standard Specification for Fiber-Reinforced Concrete
ASTM C1152/C1152M	(2020) Standard Test Method for Acid-Soluble Chloride in Mortar and Concrete
ASTM C1157/C1157M	(2020a) Standard Performance Specification for Hydraulic Cement
ASTM C1202	(2019) Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
ASTM C1231/C1231M	(2015) Standard Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders
ASTM C1260	(2021) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1567	(2021) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2018) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C1610/C1610M	(2021) Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique
ASTM C1611/C1611M	(2021) Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM C1621/C1621M	(2017) Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D512	(2012) Chloride Ion in Water
ASTM D516	(2016) Standard Test Method for Sulfate Ion in Water
ASTM D1179	(2016) Standard Test Methods for Fluoride Ion in Water
ASTM D1751	(2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D3867	(2016) Standard Test Methods for Nitrite-Nitrate in Water
ASTM D6690	(2015) Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM E329	(2021) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2018) Manual of Standard Practice
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U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 61	(1989A) Test Method for Determining the Resistance of Freshly Mixed Concrete to Washing Out in Water
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-S-200	(Rev E; Notice 1; Notice 2) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement
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1.3 DEFINITIONS

- a. "Atmospheric zone" is any portion of the waterfront structure above the splash zone.
- b. "Buried zone" is any portion of the structure permanently buried in soil.

- c. "Cementitious material" as used herein shall include portland cement and any pozzolanic material such as fly ash, and ground granulated blast-furnace slag.
- d. "Concrete System" is the term describing a structural element comprised of concrete, reinforcing steel and concrete cover.
- e. "Design strength" (f'_c) is the specified compressive strength of concrete at time(s) specified by Contracting Officer to meet structural design criteria. Typical duration is 28 days; however, the Contracting Officer and Engineer of Record are encouraged to consider specifying strength at 56 or 90 days. For concrete mixtures containing 35 percent fly ash or more, the duration must be a minimum of 56 days.
- f. "Field test strength" (f_{cr}) is the required compressive strength of concrete to meet structural and durability criteria. Determine (f_{cr}) during mixture proportioning process.
- g. "High-volume fly ash concrete" has a minimum of 35 percent Class F fly ash as a partial replacement to portland cement.
- h. "Marine concrete" is all concrete that will be in contact with seawater or brackish water, tidal variations, splash, or spray from water in navigable waterways. Piles driven on land that extend below the water table that contains saltwater or brackish water shall be designed as marine concrete. Components of a marine structure that are permanently buried in soil shall be considered marine concrete. In addition, structures may need to be designed using these criteria even though they are not adjacent to the waterfront. For example, structures located several hundred yards from the waterfront often deteriorate prematurely due to salt spray and salt fog brought to the structure by prevailing winds. An assessment of existing structures near the construction site can be an excellent indicator for the Engineer of Record and Contracting Officer to decide if the proposed structure should follow the guidelines for marine concrete.
- i. "Mixture proportioning" is the process of designing concrete mixture proportions to enable it to meet the strength, durability and constructability requirements and of the project while minimizing the initial and life-cycle cost.
- j. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic yard or meter) of concrete.
- k. "Pozzolan" is a siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.
- l. "Process control sampling" is sampling and testing conducted by the Contractor to monitor the quality of materials or processes. Process control sampling is intended to indicate the quality of materials at critical steps in production that allow intervention prior to using a material on the project.
- m. "Quality Acceptance Limit" (QAL) is the limiting value of a test

result that indicates acceptable material quality. Quality acceptance limits are based on design criteria that may be either upper-bound limits where smaller values indicate acceptable material, such as D_{oh} ; or lower-bound limits where larger values indicate acceptable material, such as compressive strength.

- n. "Quality acceptance sampling" is sampling and testing conducted by the Contractor, or an independent testing agency, to evaluate the quality of materials used on the project. Quality acceptance sampling is conducted at regular intervals identified as "lots" to represent the quality of that portion of the material used in the project.
- o. "Required compressive strength" (f'_c) is the mean compressive strength of concrete required to meet structural criteria. The required strength is the mean concrete strength for tests of properly batched concrete at the age specified herein.
- p. "Service life" is the Contracting Officer's stated expectation for the number of years that the structure will function without needing major concrete rehabilitation. A service life of 75 years for pile supported piers, wharves and bridges is a reasonable objective. Service life is defined as the number of years before major restoration is necessary given minimal maintenance to the structure during its life. Major restoration is defined as extensive areas that require extensive repairs using a jack hammer or other destructive means to prepare the concrete for rehabilitation. Service life is further defined as the summation of the corrosion initiation period (T_i) and the corrosion propagation period (T_p) for a given concrete system.
- q. "Service Life Modeling" in the context of this document refers to a methodology to predict the length of time in service at which a defined level of deterioration will occur. Service life modeling is not required in this specification.
- r. "Splash zone" is the portion of the structure just above the tidal zone. This portion of the structure is predominantly dry, but is likely to intermittently wet by wave action and wind driven spray. For the purposes of this specification, the splash zone is defined as follows:
 - (1) for locations protected by seawalls or otherwise sheltered from open-ocean waves, the 6 feet area just above the tidal zone;
 - (2) for unprotected locations, the 20 feet area just above the tidal zone.
- s. "Submerged zone" is defined as the submerged portion of the structure. For the purposes of this specification, any element or portion thereof that is located below Mean Lower Low Water (MLLW). In areas with minimal tides, it would be defined as that portion of the element below Mean Sea Level (MSL).
- t. "Supplemental Corrosion Protection" includes (but is not limited to) fusion-bonded epoxy-coated steel reinforcing, galvanized steel reinforcing, stainless reinforcing, corrosion inhibitors, barrier coatings to the concrete surface, and cathodic protection.
- u. "Supplementary cementing materials" (SCM) include coal fly ash,

granulated blast-furnace slag, natural or calcined pozzolans, and ultra-fine coal ash when used in such proportions to replace the portland cement that result in considerable improvement to sustainability, durability and in some cases a reduction in initial cost.

- v. "Test Section" is a slab or wall separate from the main structure and constructed prior to main construction as an all inclusive demonstration of methods and materials. The adequacy of the Test Section must be approved by the Contracting Officer's representative prior to construction of the project.
- w. "Tidal zone" is defined as the portion of the structure regularly wetted by wave action. For the purposes of this specification, any element or portion thereof that is located between Mean Lower Low Water (MLLW) and Mean Higher High Water (MHHW) is in the tidal zone. In areas with minimal tides, this would be defined as the area located between Mean Sea Level (MSL) and Mean High Water (MHW).

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

- Concrete Curing Plan
- Concrete Qualification Program; G
- Concrete Quality Control Program; G
- Concrete Placement and Compaction
- Concrete Pumping
- Curing Concrete Elements
- Form Removal Schedule
- Laboratory Qualifications; G
- Quality Control Personnel Qualifications; G

SD-02 Shop Drawings

- Construction and Expansion Joints; G
- Formwork
- Joints; G
- Reinforcing Steel; G
- Reproductions of contract drawings are unacceptable.

SD-03 Product Data

- Admixtures; G
- Air Entraining; G
- Aggregates; G
- Headed Reinforcing Bars; G
- Hydrophilic Waterstops; G
- Joint Filler
- Joint Sealants
- Materials for Curing Concrete
- Material Safety Data Sheets
- Mechanical Reinforcing Bar Connectors; G
- Non-Shrink Grout
- Preformed Joint Filler
- Reinforcing Bars; G
- Reinforcement Supports
- Synthetic Fibers; G
- Waterstops
- Welded Wire Fabric
- SD-04 Samples
 - Test Section
- SD-05 Design Data
 - Concrete Mixture Requirements; G
 - Mixture Designs
- SD-06 Test Reports
 - Air Entraining
 - Aggregates
 - Admixtures
 - Cement
 - Concrete Mixture Proportions
 - Concrete Test Reports

Fresh Concrete Properties

Hardened Concrete Properties

Mechanical Reinforcing Bar Connectors

Reinforcing Bars

Supplementary Cementing Materials

Water

SD-07 Certificates

Admixtures

Cementitious Materials

Cementitious Material Mill Certificates

Field Testing Technician and Testing Agency

SD-11 Closeout Submittals

Aggregate Moisture Content

Aggregate Sampling

Concrete Test Reports

Quality Control Charts

Daily Inspection Reports

Sampling Logs

1.5 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.6 DELIVERY, PLACING, STORAGE, AND HANDLING OF CONCRETE

Follow ACI 301, ACI 304R, and ASTM A934/A934M requirements and recommendations. Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed.

1.7 CONCRETE QUALITY CONTROL

The objective of the concrete quality control program is for the Contractor to outline the procedures that will be used to construct a

structure that will meet the project criteria. The Contractor must develop and submit for approval a concrete quality control program in accordance with the guidelines of ACI 121R and as specified herein. The plan shall include approved laboratories. The Contractor must provide direct oversight for the concrete qualification program inclusive of associated sampling and testing. If concrete cylinders tested during production indicate inadequate strength, excessive chloride ion penetration, or inadequate mixing, then the Contracting Officer may require the Contractor to extract concrete core samples from the hardened concrete for analysis at Contractor's expense to assure that the quality of the concrete as placed and cured will satisfy the project criteria.

Develop and submit for approval a concrete quality control program in accordance with the guidelines of ACI 121R. Maintain a copy of ACI SP-15 and CRSI 10MSP at the project site.

1.7.1 Quality Control Personnel

The Contractor must submit for approval an organizational chart defining the quality control hierarchy, the responsibilities of the various positions, including the names and qualifications of the individuals in those positions.

Submit American Concrete Institute certification for the following:

- a. CQC personnel responsible for inspection of concrete operations.
- b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews.
- c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.
- d. Laboratory Testing Technicians: ACI Concrete Strength Testing Technician and Laboratory Testing Technician, Grade I or II.
- e. Petrographer: Bachelor of Science degree in geology or petrography, trained in petrographic examination of concrete aggregate according to ASTM C294 and ASTM C295/C295M and trained in identification of the specific deleterious processes and tests identified in this specification. Resume must detail the education, training and experience related to the project-specific test methods and deleterious materials and shall be submitted at least 20 days before petrographic and deleterious materials examination is to commence.
- f. Concrete Batch Plant Operator: National Ready Mix Concrete Association (NRMCA) Plant Manager Certification at the Plant Manager level.

1.7.1.1 Quality Manager Qualifications

The quality manager must hold a current license as a professional engineer in a U.S. state or territory with experience on at least five similar projects. Evidence of extraordinary proven experience may be considered by the Contracting Officer as sufficient to act as the Quality Manager.

1.7.1.2 Field Testing Technician and Testing Agency

Submit data on qualifications of proposed testing agency and technicians for approval by the Contracting Officer prior to performing testing on

concrete.

- a. Work on concrete under this contract shall be performed by an ACI Concrete Field Testing Technician Grade 1 qualified in accordance with ACI SP-2 or equivalent. Equivalent certification programs shall include requirements for written and performance examinations as stipulated in ACI SP-2.
- b. Testing agencies that perform testing services on reinforcing steel shall meet the requirements of ASTM E329.
- c. Testing agencies that perform testing services on concrete materials shall meet the requirements of ASTM C1077.

1.7.2 Laboratory Qualifications for Concrete Qualification Testing

The concrete testing laboratory must have the necessary equipment and experience to accomplish required testing. The laboratory must meet the requirements of ASTM C1077, and be Cement and Concrete Reference Laboratory (CCRL) inspected.

1.7.3 Laboratory Accreditation

Laboratory and testing facilities must be provided by and at the expense of the Contractor. The laboratories performing the tests must be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation must be current and must include the required test methods, as specified.

- a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies must be performed by an accredited laboratory and under the direction of a licensed/registered civil engineer in a U.S. state or territory, who shall sign all reports and designs.
- b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M.
- c. Contractor Quality Control: All sampling and testing must be performed by an approved, onsite, independent, accredited laboratory.

1.8 CONCRETE DURABILITY

1.8.1 Concrete Mixture Proportions

At least 60 days prior to concrete placement, submit concrete mixture proportions, ingredient material certificates and test data, and trial batch test data for each class of concrete proposed for use on the project. Submittal shall clearly indicate where each mixture will be used when more than one mixture design is submitted. Obtain approval from Contracting Officer prior to placement.

1.8.2 Concrete Design Requirements

Proportion concrete mixtures to meet the requirements listed in Table 1 in accordance with the procedures outlined in ACI 201.2R and ACI 211.1.

The mixture proportions for concrete shall be developed by the Contractor to produce the required compressive strength (f'c), drying shrinkage, durability, and constructability. The amount of cementitious material in the mixture can be minimized as long as the concrete still meets the mixture design requirements for durability and strength.

The mixture proportions and Water-Cementitious Materials Ratio for marine concrete shall be developed by the Contractor to produce the design strength (f'c) and to provide durability, workability, and mixture consistency to facilitate placement, compaction into the forms and around reinforcement without segregation or bleeding. The requirements for durability specified in Table 1 and Table 2 below shall be incorporated in the mixture proportions.

The use of silica fume is not permitted.

The concrete mixture shall contain one of the CCM/SCM listed in Table 3, or a linear combination thereof. The minimum amount of portland cement is 50 percent of the total mass of cementitious material.

The concrete mixture for pier and trestle topping slabs and curbs must contain synthetic fibers as indicated in Paragraph 2.4.6.

Air content: Concrete shall be air entrained and must conform to the air limits specified in ACI 301 for exposure and the aggregate size used and tested in accordance with ASTM C231/C231M. The average spacing factor for three consecutive tests shall not exceed 0.008 in with no individual test exceeding 0.010 in as determined by ASTM C457/C457M. Variations outside the limits specified shall not be reason to reject the concrete in locations not subject to freeze-thaw conditions.

Slump: The concrete mixture shall be proportioned to have, at the point of deposit, a maximum slump of 4 inches as determined by ASTM C143/C143M when admixtures that affect slump are not used. Where an ASTM C494/C494M, Type F or G admixture is used, the slump after the addition of the admixture shall not exceed 8 inches. Slump tolerances shall comply with the requirements of ACI 117.

Table 1 - Concrete Design Requirements		
Prescriptive requirements	Minimum	Maximum
ASTM C666/C666M Method A Durability Factor at 300 cycles	90	--
Concrete ASTM C157/C157M Drying Shrinkage percent, at 28 days except for high volume fly ash (HVFA) at 56 days.	--	0.05 percent
Initial acid-soluble chloride content in cast-in-place concrete per ASTM C1152/C1152M, percent/cement	--	0.10
Initial acid-soluble chloride content in prestressed concrete determined following ASTM C1152/C1152M, percent/cement	--	0.08

Table 1 - Concrete Design Requirements		
Prescriptive requirements	Minimum	Maximum
Average spacing factor for three specimen following ASTM C457/C457M inch	--	0.008 with no value greater than 0.010
Chloride ion penetrability ASTM C1202 at 56 days, Coulombs	--	1000
Alternatively to ASTM C1202, the concrete surface resistivity AASHTO T 358 at 56 days can be measured, kohm-cm	20	--

Table 2 - Concrete Quality Requirements		
Zone	Exposure Condition	Maximum W/CM
Submerged zone, Tidal Splash Zone	(a) Directly exposed to salt water	0.40
	(b) Subject to severe abrasion	0.40
Atmospheric Zone	(a) Directly exposed to marine atmosphere	0.40
	(b) Protected from direct exposure to marine atmosphere	0.45
Buried Zone	(a) Permanently buried in soil	0.40

Table 3 - Supplementary Cementing Material Requirements	
SCM	Minimum Content
Class N Pozzolan or Class F Fly Ash SiO ₂ plus Al ₂ O ₃ plus Fe ₂ O ₃ > 65 percent or where exposed to sulphates as defined in ACI 318 Table 4.2.1	30 percent
Class N Pozzolan or Class F Fly Ash SiO ₂ plus Al ₂ O ₃ plus Fe ₂ O ₃ greater than 70 percent	25 percent
Class N Pozzolan or Class F Fly Ash SiO ₂ plus Al ₂ O ₃ plus Fe ₂ O ₃ greater than 80 percent	20 percent
Class N Pozzolan or Class F Fly Ash SiO ₂ plus Al ₂ O ₃ plus Fe ₂ O ₃ greater than 90 percent	15 percent

Table 3 - Supplementary Cementing Material Requirements	
Ultra fine fly ash/Pozzolan	7 percent
Ground granulated blast-furnace slag	40 percent

1.8.3 Concrete Mixture Qualifications

1.8.3.1 Previously Approved Concrete Mixtures

For identical concrete mixtures previously approved for use within the past 18 months, the previous mixture qualification submittal may be re-submitted without further trial batch testing if accompanied by:

- a. A copy of the prior approvals indicating the project name, project number, and location.
- b. Ingredient material test data conducted within 12 months of the submittal date.
- c. Copies of the previously approved trial batch test data.
- d. A log containing at least 15 sequential test results with the calculated mean and standard deviation of the production concrete for air content, and compressive strength.

If the Contractor changes material type, class, sources, or suppliers; chemical composition; and/or mix proportions, the Contractor shall provide a written opinion of the significance of the change(s). The change(s) may require additional testing at the discretion of the Contracting Officer in consultation with the agency's Subject Matter Expert in Concrete Materials.

1.8.3.2 New Concrete Mixtures

- a. Submit complete ingredient material test data, including applicable reference specifications. Submit additional data regarding concrete aggregates if the source of aggregate changes.
- b. Submit copies of test reports by independent test lab conforming to ASTM C1077 showing that the mixture has been successfully tested to produce concrete with the properties specified and that mixture will be suitable for the job conditions as described. Test reports shall be submitted along with the concrete mixture proportions. Obtain approval before concrete placement.
- c. Test a minimum of one trial batch of production concrete. If batching facilities are located such that the haul-time will exceed 30 minutes, a simulated haul time shall be included in the trial batch.
 - (1) Test and report fresh concrete property tests of each trial batch as follows:
 - (a) Slump in accordance with ASTM C143/C143M.
 - (b) Air content in accordance with ASTM C231/C231M or ASTM C173/C173M.
 - (c) Unit weight in accordance with ASTM C138/C138M.

- (d) Temperature in accordance with ASTM C1064/C1064M.
 - (2) Cast specimens, test, and report hardened concrete property tests of each trial batch as follows:
 - (a) Compressive strength at 3, 7, 28, 56 and 90 days in accordance with ASTM C39/C39M. Use of unbonded caps in accordance with ASTM C1231/C1231M is permitted.
 - (b) Drying shrinkage.
 - (c) Tensile strength (if required).
 - (d) Freeze-thaw durability factor (if required) shall be determined as the mean of six test specimens comprised of at least two specimens cast from each batch.
 - (e) Initial chloride ion content.
 - (f) Spacing factor in accordance with ASTM C457/C457M.
 - (g) Chloride ion penetrability in accordance with ASTM C1202.
 - (3) Moist cure concrete intended for cast-in-place applications in accordance with the standard moist curing conditions described in ASTM C192/C192M unless otherwise specified. Moist cure concrete intended for precast applications in the manner proposed for use on the project.
 - d. For concrete mixtures that are proposed to contain corrosion inhibitors, the Contractor shall submit the chloride ion penetration values from at least one batch of the mixture with and without the admixture making appropriate adjustments to maintain constant water to cementitious materials ratio. The purpose is to establish a correlation with respect to an adjusted value for production chloride ion penetration.
- 1.8.4 Concrete Qualification Program
- 1.8.4.1 Fresh Concrete Properties
- a. Air Content: The mixture shall be proportioned and tested for qualification.
 - b. Slump: The mixture shall be proportioned and tested for qualification.
 - c. Self-Consolidating Concrete (SCC): When SCC is proposed or indicated for use, the mixture must be proportioned and tested for qualification using:
 - (1) ASTM C1611/C1611M slump flow must not be greater than 24 inches, with visual stability index not greater than 1.
 - (2) ASTM C1621/C1621M The difference between slump flow the J-ring flow must not be more than 2 inches.
 - (3) Passing ability using the L-Box between 4 and 8 seconds

- (4) ASTM C1610/C1610M, static segregation must be less than 4.0 percent.

For process control sampling, the slump flow limit as determined by ASTM C1611/C1611M shall be no greater than 24 inches and the visual stability index limit shall be no greater than 1.0.

- d. Underwater concrete: When the concrete is intended for placement under water using the tremie technique, the concrete must be proportioned to be cohesive and flow with minimal segregation. Viscosity modifying admixtures are permitted for underwater concrete. Proportioning guidance in ACI 304R must be considered. Concrete mixtures must be qualified for tremie placement methods based on a trial placement approved by the Contracting Officer.

1.8.4.2 Hardened Concrete Properties

- a. Minimum Compressive Strength: 5,000 psi at 28 days. Determine compressive strength (f'_{cr}) for qualification of concrete mixtures and for quality acceptance testing. A compressive strength test result is defined as the mean of three properly conducted tests on 6 by 12 inch cylinders in accordance with ASTM C39/C39M. In addition:

- (1) Specified Compressive Strength: For structural concrete elements exposed in a marine environment, the minimum specified 28 day design strength is denoted as (f'_c). Strength of concrete containing 35 percent or more fly ash must be specified at a minimum of 56 days.
- (2) Required Average Strength: The concrete must be proportioned such that the minimum required average compressive strength (f'_{cr}) exceeds the specified design strength (f'_c) as per ACI 301.
- (3) The average compressive strength may not exceed the specified strength at the same age by more than 20 percent unless approved by the Contracting Officer.
- (4) Strength of any individual concrete placement shall be considered satisfactory if both the following requirements are met:
 - (a) The arithmetic mean of any three consecutive lot strength tests is between 1.0 and 1.2 f'_c , and;
 - (b) No individual strength test result is less than 0.90 f'_c .
- (5) In the event that a placement is represented by single sampling lot, strength shall be considered satisfactory if either:
 - (a) The mean of the initial test is between 1.0 and 1.2 f'_c , or;
 - (b) The mean of the initial test and retest is between 1.0 and 1.2 f'_c , and neither strength test result is less than 0.90 f'_c .

- b. Drying Shrinkage: Determine drying shrinkage for qualification of concrete topping mixtures prior to the fabrication of the Test Section and from samples made during the fabrication of the Test Section (see the paragraph TEST SECTION). No test results shall exceed the limits in Table 1. A drying shrinkage test result shall be the mean value from three or more individual specimens constituting a test set. If

an individual specimen's measurements deviate from the mean value by more than 0.009 percent length change, the specimen's measurements shall be discarded and a new average established. Casting more than three specimens for each set is permitted. Test procedures and test specimens shall conform to the following:

Drying shrinkage specimens, typically 3 by 3 by 11.25 inch prisms for 1 inch maximum size aggregate or smaller, shall be fabricated, cured, dried, and measured at 28 days in the manner delineated in ASTM C157/C157M. Mixtures containing 50 percent or more supplementary cementing materials shall meet the shrinkage criteria at 56 days.

- e. Acid Soluble Chloride Ion Content: Determine the chloride ion content only for qualification of concrete mixtures. Determine acid soluble chloride ion content in accordance with ASTM C1152/C1152M. The limits for allowable acid-soluble chloride ion concentrations in hardened concrete are listed in Table 1.
- f. Chloride Ion Penetrability: Determine the resistance of concrete to the penetration of chloride ions in accordance with ASTM C1202 during the prequalification phase. The average of three samples shall meet the limit specified Table 1.

1.8.4.3 Supplemental Corrosion Protection

Requirements for the use of supplemental corrosion protection, is required for submerged and tidal (wet-dry) concrete exposures

1.9 CONCRETE

1.9.1 Drawings

Fabrication Drawings for concrete formwork, reinforcement materials, precast elements, wall forms, and bulkhead forms must indicate concrete pressure calculations with both live and dead loads, along with material types. Provide design calculations by a registered Civil or Structural Engineer for the formwork.

1.9.1.1 Formwork

Prior to commencing work, submit drawings for approval showing details of formwork including, but not limited to: joints, supports, studding and shoring, and sequence of form and shoring removal. Reproductions of contract drawings are unacceptable.

Design, fabricate, erect, support, brace, and maintain formwork so that it is capable of supporting without failure all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork.

ACI 347R. Include design calculations indicating arrangement of forms, sizes, species, and grades of supports (lumber), panels, and related components. Indicate placement schedule, construction, and location and method of forming control joints. Include locations of inserts, pipe work, conduit, sleeves, and other embedded items. Furnish drawings and descriptions of shoring and reshoring methods proposed for slabs, beams, and other horizontal concrete members.

1.9.1.2 Reinforcing Steel

ACI SP-66. Provide bending and cutting diagrams, assembly diagrams, splicing placement and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Only complete drawings will be accepted.

1.9.1.3 Joints

Submit a plan indicating the type and location of each construction, contraction, expansion, and isolation joint. Final joint locations are subject to Government approval.

1.9.2 Pre-Construction Submittals

1.9.2.1 Curing Concrete Elements

Submit proposed materials and methods for curing concrete elements.

1.9.2.2 Concrete Curing Plan

Submit proposed materials, methods, and duration for curing and cooling concrete elements in accordance with ACI 308.1.

Minimum moist curing duration shall be seven days.

Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

1.9.2.3 Form Removal Schedule

Submit schedule for form removal indicating element and minimum length of time for form removal. Submit technical literature of forming material or liner, form release agent, form ties, and gasketing to prevent leakage at form and construction joints. Provide a full description of materials and methods to be used to patch form-tie holes.

1.9.2.4 Concrete Placement and Compaction

- a. Submit technical literature for equipment and methods proposed for use in placing concrete. Include concrete pumping or conveying equipment including type, size and material for pipe, valve characteristics, and the maximum length and height concrete will be pumped. No adjustments shall be made to the mixture design to facilitate pumping.
- b. Submit technical literature for equipment and methods proposed for vibrating and compacting concrete. Submittal shall include technical literature describing the equipment including vibrator diameter, length, frequency, amplitude, centrifugal force, and manufacturer's description of the radius of influence under load. Where flat work is to be cast, provide similar information relative to the proposed compacting screed or other method to ensure dense placement.

1.9.2.5 Concrete Report

Provide a Report inclusive of materials and methods used, test results, and the field test strength (fcr) for concrete that shows compliance with the structural and durability requirements.

1.9.2.6 Preconstruction Testing of Materials

All sampling and testing shall be performed by, and at the expense of, the Contractor. Use an approved commercial laboratory or, for cementitious materials and chemical admixtures, a laboratory maintained by the manufacturer of the material. No material shall be used until notice of acceptance has been given. The Contractor will not be entitled to any additional payment or extension of time due to failure of any material to meet project requirements, or for any additional sampling or testing required. Additional tests may be performed by the Government at the discretion of the Contracting Officer; such Government testing will not relieve the Contractor of any testing responsibilities.

1.9.2.7 Material Safety Data Sheets

Submit Material Safety Data Sheets (SDS) for all materials that are regulated for hazardous health effects. Prominently post the SDS at the construction site.

1.9.2.8 Mixture Designs

Provide a detailed report of materials and methods used, test results, and the field test strength (fcr) for marine concrete required to meet structural and durability requirements.

1.9.3 Sampling

The Contractor shall be responsible for conducting concrete production process control sampling and testing in compliance with this specification.

1.9.3.1 Ingredient Material Sampling

- a. Cementitious material mill certificates and test reports shall be provided for each shipment. Record the date delivered and quantity of material represented by the certificate.
- b. Conduct and log aggregate moisture content at a minimum frequency of twice daily for each day's production. Use of moisture sensors in storage bins is recommended practice, but does not satisfy this requirement.
- c. Aggregate sampling for gradation and dry-rodded unit weight shall be conducted for each 100 tons delivered for use on the project, or portion thereof.

1.9.4 Reporting

1.9.4.1 Daily Inspection Reports

Contractor shall prepare daily inspection reports for all inspection activities such as base preparation, formwork preparation, reinforcement installation, concrete placement log, and temperature control activities. Submit sample forms and describe the procedure used to organize, archive,

and retrieve inspection records in the Quality Program submittal.

1.9.4.2 Sampling Logs

Contractor shall maintain a concrete placement log as an electronic spreadsheet or database identifying each placement date, placement location, volume of concrete, batch ticket numbers, lot identification code, fresh concrete properties, compressive strength results, transport properties, inspection comments, and acceptance status. Contractor shall provide/transmit the concrete testing log to the Contracting Officer weekly. The Contractor shall provide copies of supporting documents for any placement requested by the Contracting Officer immediately upon request.

1.9.4.3 Quality Control Data

The Contractor shall prepare, maintain, and report separate quality control charts illustrating the slump, temperature, plastic air content, compressive strength, and chloride ion penetration test results for each lot of each concrete mixture used on the project.

1.9.4.4 Non-conforming Materials

The exact location of non-conforming concrete as placed shall be identified and the Contracting Officer and Engineer of Record shall be notified immediately. There are numerous possible indicators that the as-placed concrete is non-conforming including (but not limited to) excessive compressive strength, inadequate compressive strength, excessive slump, chloride ions penetration out of limits, excessive voids and honeycombing, and concrete delivery records that indicate excessive time between mixing and placement and/or excessive water was added to the mixture during delivery and placement. Any of these indicators alone are sufficient reason for the Contracting Officer to request additional sampling, testing, and service life modeling to quantify the concrete properties. If justified, cores may be extracted for testing, and an investigation into the cause for non-conformance shall be conducted. The investigation may include statistical analysis of the test data collected to date; appropriateness of the pre-defined QAL based on statistical analysis of production data; the impact of the non-conforming material on the structure strength and/or service life; and recommendations for concrete production process improvements, mitigation, or remediation, as appropriate.

Investigations into non-conforming materials shall be conducted at the Contractor's expense. The Contractor shall be responsible for the investigation and shall make written recommendations to adequately mitigate or remediate the non-conforming material. The Contracting Officer may accept, accept with reduced payment, require mitigation, or require removal and replacement of non-conforming material at no additional cost to the Government.

1.9.5 Test Reports

Concrete Test Reports shall be identified by a sequential report identification code. Each report shall identify the placement date, placement location, weather, name of testing technician, time of sampling, batch ticket number, fresh concrete test results, and hardened concrete test results.

1.9.5.1 Concrete Mixture Requirements

- a. Submit copies of test reports conforming to ASTM C1077 showing that the mixture has been successfully tested to produce concrete with the properties specified and that mixture will be suitable for the job conditions. Test reports shall be submitted along with the concrete mixture proportions. Obtain approval before concrete placement.
- b. Fully describe the processes and methodology whereby mixture proportions were developed and tested and how proportions will be adjusted during progress of the work to achieve, as closely as possible, the designated levels of relevant properties.
- c. Topping slab must contain shrinkage controlling admixture.
- d. Marine concrete with tidal or immersed exposure must contain an. Calcium Nitrite corrosion inhibitor. This includes the first stage pile caps, but does not include the grout used to attach the HDPE pile jackets.

1.9.5.2 Supplementary Cementing Materials

Submit test results in accordance with ASTM C618 and the physical and chemical analysis in accordance with applicable ASTM standards such as ASTM C311/C311M for fly ash. Submit test results performed within 6 months of submittal date. Update this report during construction as necessary to assure that the supplementary cementing materials used on the projects meets the ASTM criteria and the report on file is never older than 6 months.

1.9.5.2.1 Ground Granulated Blast-Furnace Slag

Submit test results in accordance with ASTM C989/C989M for ground granulated blast-furnace slag. Submit test results performed within 6 months of submittal date. Update this report during construction as necessary to assure that the report on file is never older than 6 months.

1.9.5.2.2 Ultra Fine Fly Ash or Pozzolan

Submit test results in accordance with ASTM C618 as a Class F fly ash or Class N pozzolan with the following additional requirements:

- a. The strength activity index at 28 days shall be at least 95 percent of the control.
- b. The average particle size shall not exceed 6 microns.
- c. The sum SiO_2 plus Al_2O_3 plus Fe_2O_3 shall be greater than 77 percent.

Submit test results performed within 6 months of submittal date. Update this report during construction as necessary to assure that the report on file is never older than 6 months.

1.9.5.3 Silica Fume

Silica fume is not permitted.

1.9.5.4 Aggregates

Aggregate samples shall be obtained in accordance with ASTM D75/D75M and must be representative of the materials to be used for the project. Submit test results for aggregate quality in accordance with ASTM C33/C33M, and the combined gradation curve proposed for use in the work and used in the mixture qualification, and ASTM C295/C295M for results of petrographic examination. Confirm that the potential for alkali-silica reaction are within allowable limits by conducting tests in accordance with ASTM C1260. Submit results of all tests during progress of the work in tabular and graphical form as noted above, describing the cumulative combined aggregate grading and the percent of the combined aggregate retained on each sieve. Submit test results performed within 12 months of submittal date.

1.9.5.5 Admixtures

Submit test results in accordance with ASTM C494/C494M and ASTM C1017/C1017M for concrete admixtures, ASTM C260/C260M for air-entraining admixture, and manufacturer's literature and test reports for corrosion inhibitors and anti-washout admixture. Submitted data shall be based upon tests performed within 6 months of submittal. Submit certified copies of test results for the specific lots or batches to be used on the project. Test results shall be not more than 6 months old prior to use in the work. Chemical admixtures that have been in storage at the project site for longer than 6 months or that has been subjected to freezing will be retested at the expense of the Contractor.

1.9.5.6 Portland Cement

Portland cement, ground granulated blast furnace (GGBF) slag, and pozzolan will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports showing that the material in each shipment meets the requirements of the specification under which it is furnished. Mill test reports shall be no more than 1 month old, prior to use in the work. No cementitious material shall be used until notice of acceptance has been given by the Contracting Officer. Cementitious material may be subjected to check testing by the Government from samples obtained at the mill, at transfer points, or at the project site. If tests prove that a cementitious material that has been delivered is unsatisfactory, it shall be promptly removed at Contractor's expense from the site of the work. Cementitious material that has not been used within 6 months after testing shall be retested at the Contractor's expense and shall be rejected if test results are not satisfactory. Submit test results in accordance with ASTM C150/C150M portland cement and/or ASTM C595/C595M and ASTM C1157/C1157M for blended cement.

1.9.5.7 Testing During Construction

During construction, the Contractor is responsible for sampling and testing aggregates, cementitious materials, and concrete as specified herein. The Government will sample and test concrete and ingredient materials as considered appropriate. Provide facilities and labor as may be necessary for procurement of representative test samples. Testing by the Government will in no way relieve the Contractor of the specified testing requirements.

1.9.5.8 Test Section

- a. Horizontal Placements. No more than 90 days prior to construction, construct a Topping Test Section 10 by 10 feet by 16 inches thick over hardened concrete near the job site, but not as part of the structure. The Test Section shall meet all specification requirements and be acceptable to the Contracting Officer in all respects, including but not limited to delivery time, placement, consolidation, curing and surface texture. Use the Test Section to develop and demonstrate to the satisfaction of the Contracting Officer the proposed techniques of mixing, hauling, placing, consolidating, finishing, curing, initial saw cutting, start-up procedures, testing methods, plant operations, and the preparation of the construction joints. The mixing plant shall be operated and equipment calibrated prior to start of placing the Test Section. Use the same equipment, materials, and construction techniques on the Test Section as will be used in all subsequent work. Concrete production, placing, consolidating, curing, construction of joints, and all testing shall be in accordance with applicable provisions of this specification. At a minimum of three days after completion of the Test Section, extract a sufficient number of concrete cores 4 by 8 inch to conduct tests to evaluate strength, air void spacing factor, homogeneity, consolidation, segregation, and chloride ion penetration properties. Test Results that are unacceptable Test Section will necessitate construction of an additional Test Section at no additional cost to the Government

1.9.5.9 Acceptability of Work

The materials and the structure itself will be accepted on the basis of tests made by the Contractor and shall be in compliance with the criteria herein. The Government may make check tests at its expense to validate the results of the Contractor's testing. Testing performed by the Government will in no way relieve the Contractor from the specified testing requirements.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement or cement blended with supplementary cementing materials. New submittals are required when the cementitious materials change sources or types.

The Contractor shall provide cementitious materials meeting the requirements of the applicable specification, and as modified herein. Provide mill certificates and test results conducted within six-months of the submittal date as part of the concrete mixture qualification submittal.

Provide a single manufacturer of cementitious material for each type of cement and supplementary cementing materials supplied to the project.

2.1.1 Portland Cement

Provide portland cement conforming to ASTM C150/C150M, Type I/II, low alkali with tri-calcium aluminates (C3A) content less than 10 percent and a maximum cement-alkali content of 0.80 percent Na₂O_e (sodium oxide equivalent). Type III cement shall not be used. When HVFA mixtures are specified, they should be blended with Type II portland cement. HVFA is

required instead of using Type V cement in high-sulfate areas. Low alkali cement may be required if the proposed aggregates are found to be expansive.

ASTM C150/C150M cements shall be combined with supplementary cementing materials in the concrete mixture.

2.1.2 Blended Cements

Blended cement shall conform to ASTM C595/C595M, Type IP or IS, including the optional requirement for mortar expansion and sulfate soundness and consist of a mixture of ASTM C150/C150M Type I, or Type II cement and a supplementary cementing material. The slag added to the Type IS blend shall be ASTM C989/C989M ground granulated blast-furnace slag. The pozzolan added to the Type IP blend shall be ASTM C618 Class F and shall be interground with the cement clinker. The manufacturer shall state in writing that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot-to-lot or within a lot. The percentage and type of mineral admixture used in the blend shall not change from that submitted for the aggregate evaluation and mixture proportioning.

2.1.3 Pozzolan

2.1.3.1 Fly Ash

Fly ash shall conform to ASTM C618, Class F, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 6 percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity shall have a Calcium Oxide (CaO) content of less than 8 percent and a total equivalent alkali content less than 1.5 percent. Add with cement.

2.1.3.2 Raw or Calcined Natural Pozzolan

Natural pozzolan shall be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 3 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity shall have a Calcium Oxide (CaO) content of less than 13 percent and total equivalent alkali content less than 3 percent.

2.1.3.3 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) shall conform to ASTM C618, Class F or N, and the following additional requirements:

- a. The strength activity index at 28 days of age shall be at least 95 percent of the control specimens.
- b. The average particle size shall not exceed 6 microns.
- c. The sum of $\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$ shall be greater than 77 percent.

2.1.4 Ground Granulated Blast-Furnace (GGBF) Slag

Ground Granulated Blast-Furnace Slag shall conform to ASTM C989/C989M, Grade 120. Add with cement.

2.1.5 Silica Fume

Silica fume is not permitted

2.1.6 Supplementary Cementitious Materials (SCM) Content

The concrete mix shall always contain supplementary cementing materials whether or not the aggregates are found to be reactive in accordance with the paragraph AGGREGATES. Concrete mixtures shall be designed and proportioned to meet the requirements for strength, constructability, shrinkage, and durability.

2.2 AGGREGATES

Comply with ASTM C33/C33M Class 4S, except as modified herein.

The quantities to be retained on each sieve may be adjusted only where available aggregates are elongated or slivered and cause interference with mix mobility, or available aggregate gradations do not comply with the 18-8 requirement. When necessary to satisfy local conditions and when permitted, the combined aggregate percentages may be changed to not more than 22 percent nor less than 6 percent retained on any individual sieve. The combined aggregates in the mixture (coarse, intermediate, and fine) shall be well graded with no more than 18 percent nor less than 8 percent of the combined aggregate retained on any individual sieve, unless satisfactory performance can be demonstrated. The No. 50 sieve may have less than 8 percent retained; sieves finer than No. 50 shall have less than 8 percent retained, and the coarsest sieve may have less than 8 percent retained. Use intermediate sizes for blending where necessary, to provide a well graded combined aggregate.

- a. Provide gradation of individual aggregate sizes using standard concrete aggregate sieves including 1-1/2 inches, one inch, 3/4 inch, 1/2 inch, 3/8 inch, No. 4, No. 8, No. 16, No. 30, No. 50, and No. 100.
- b. Provide aggregates for exposed concrete from one source. Aggregate reactivity shall be limited per the paragraph AGGREGATES. Provide aggregate containing no deleterious material properties as identified by ASTM C295/C295M.
- c. Where a size designation is indicated, that designation indicates the nominal maximum size of the coarse aggregate.
- d. Aggregate tests shall be conducted within 6 months from the date of concrete mixture submittal.
- e. Provide ASTM C1260 or ASTM C1567 test results conducted with 6 months of the submittal date showing the proposed coarse and fine aggregates are either: innocuous to alkali silica reaction; or that reactivity has been mitigated by the proposed cementitious materials as modified herein. Maximum allowable expansion is 0.08 percent at 14 days per ASTM C1260. If this is not met, then maximum allowable expansion for the proposed concrete mixture/s shall be 0.08 percent at 14 days per ASTM C1567. All aggregate sources shall be tested. Also, provide documentation that the aggregate has no history of chemical deterioration in concrete. Fine and coarse aggregates to be used in all concrete shall be evaluated and tested for alkali-aggregate reactivity. Both coarse aggregate size groups shall be tested.

- f. Should the test data indicate a potential risk of alkali-aggregate reaction, the aggregate(s) shall be rejected or procedures from AASHTO R 80 shall be followed.

2.3 WATER

Water shall comply with the requirements of ASTM C94/C94M and ASTM C1602/C1602M, except that the chloride and sulfate limits as tested in accordance with ASTM D512 and ASTM D516 shall not exceed 500 parts per million chloride ion and not more than 1000 parts per million of sulfate ion as SO₄. Water shall be potable and free from injurious amounts of oils, acids, alkalis, salts, and organic materials. Submit test results in accordance with ASTM D512 and ASTM D516.

2.4 ADMIXTURES

- a. Provide certifications that chemical admixtures comply with the requirements shown in Table 4 and are compatible with each other. Use admixtures in accordance with manufacturer's recommendations, as appropriate for the climatic conditions and construction needs.
- b. Do not use calcium chloride or admixtures containing chloride ion content in more than trace amounts from impurities in admixture ingredients or potable water. Provide maximum concentrations of corrosion-inducing chemicals as shown in Table 4. For concrete that may be in contact with prestressing steel tendons, the concentration shall not exceed 60 percent of the limits given in Table 4. For the concentration in grout for prestressing ducts, do not exceed 25 percent of the limits in Table 4.

Table 4 - Limits on Corrosion-Inducing Chemicals		
Chemical*	Limits, Percent**	Test Method
Chlorides	0.10	ASTM D512
Fluorides	0.10	ASTM D1179
Nitrates	0.17	ASTM D3867
* Limits refer to water-soluble chemicals		
** Limits are expressed as a percentage of the mass of the total cementitious materials.		

- c. The total alkali contribution of chemical admixtures shall not increase the total sodium-oxide equivalent content of the concrete mixture by more than 0.5 lb/yd³.

2.4.1 Air Entraining

Provide air entraining admixtures conforming to ASTM C260/C260M

2.4.2 Accelerating

ASTM C494/C494M, Type C.

2.4.3 Retarding

ASTM C494/C494M, Type B, D, or G.

2.4.4 Shrinkage Reducting

ASTM C494/C494M Type S typically dosage between 8 and 30 fluid ounces per 100 lbs of cementitious for topping slab use.

2.4.5 Water Reducing

ASTM C494/C494M, Type A, E, or F.

High Range Water Reducer (HRWR) shall be ASTM C494/C494M, Type F and ASTM C1017/C1017M.

2.4.6 Corrosion Inhibitors

Corrosion inhibitors are considered "supplemental corrosion protection". If used, adjust the quantity of concrete mixing water for the mass of water in the admixture. Accelerating and set adjusted versions are acceptable. Concrete setting time and mixture workability shall be evaluated.

2.5 NON-SHRINK GROUT

ASTM C1107/C1107M.

2.6 MATERIALS FOR FORMS

Provide wood, plywood, or steel. Use plywood or steel forms where a smooth form finish is required. Lumber shall be square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects.

Plywood: APA PS 1, B-B concrete form panels or better. Steel form surfaces shall not contain irregularities, dents, or sags.

2.6.1 Form Ties and Form-Facing Material

- a. Provide a form tie system that does not leave mild steel after break-off or removal any closer than 3 inches from the exposed surface. Do not use wire alone. Form ties and accessories shall not reduce the effective cover of the reinforcement.
- b. Form-facing material shall be structural plywood or other material that can absorb air and some of the high water-cementitious materials ratio surface paste that may be trapped in pockets between the form and the concrete. Maximum reuse is three times. Provide forms with a form treatment to prevent bond of the concrete to the forms. Use a controlled permeability form liner in strict accordance with the manufacturer's recommendations.

2.7 REINFORCEMENT

2.7.1 Reinforcing Bars

ACI 301 unless otherwise specified and shall meet the design yield

strength and ductility requirements. Deformed reinforcing bars meeting the requirements of ASTM A706/A706M, Grade 60 prefabricated and then coated in accordance with ASTM A767/A767M Class 1 galvanized after fabrication.

2.7.2 Mechanical Reinforcing Bar Connectors

ACI 301. Provide 125 percent minimum yield strength of the reinforcement bar. Coat connectors in accordance with the requirements of the reinforcing bars.

2.7.3 Welded Wire Fabric

Comply with ASTM A1064/A1064M carbon steel, galvanized.

2.7.4 Headed Reinforcing Bars

ASTM A970/A970M, galvanized in accordance with ASTM A767/A767M Class 1.

2.7.5 Wire

Comply with ASTM A1064/A1064M carbon steel, galvanized.

2.7.6 Synthetic Fibers

In addition to the requirements specified above, cast-in-place concrete topping slab and curbs on the pier and trestle must include micro-synthetic fibers in accordance with ASTM C1116/C1116M at a dosage rate of 0.5 lbs/yd³. Fibers shall be MasterFiber[®]M 100 by BASF, PSI Fiberstrand F by Euclid Chemical, SikaFiber[®] PPM 150 by Sika, or approved equal. Fibers shall be added at the batch plant and uniformly dispersed in concrete mixture as recommended by the manufacturer.

2.8 ACCESSORY MATERIALS

2.8.1 Polyvinylchloride Waterstops

COE CRD-C 572.

2.8.2 Hydrophilic Waterstops

Hydrophilic Waterstops must be used for cold/construction joints, where indicated. A conformable, swellable polymer/butyl rubber waterstop strip that expands when in contact with saline and brackish water. When fully encapsulated in poured concrete, the expansive forces form a seal against concrete faces. The waterstop must have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.

The waterstop must conform to the following requirements when tested in accordance to ASTM D412:

- a. Tensile Strength 420 psi minimum;
- b. Ultimate elongation 600 percent minimum;
- c. Hardness 50 minimum on the type A durometer; and
- d. Volumetric expansion ratio in distilled water at 70 degrees F must be 3 to 1 minimum.

2.8.3 Materials for Curing Concrete

2.8.3.1 Impervious Sheeting

ASTM C171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.8.3.2 Pervious Sheeting

AASHTO M 182 or carpet covering the free surface and kept continuously wet throughout the curing period.

2.8.4 Expansion/Contraction Joint Filler

Comply with ASTM D1751 or ASTM D1752, 1/2 inch thick unless otherwise indicated.

2.8.5 Joint Sealants

2.8.5.1 Horizontal Surfaces

Horizontal surfaces are defined as all surfaces with a 3 percent maximum slope. ASTM D6690 or ASTM C920, Type M, Class 25, Use T.

2.8.5.2 Vertical Surfaces

Vertical surfaces are defined as all surfaces with a slope greater than 3 percent. ASTM C920, Type M, Grade NS, Class 25, Use T. FS SS-S-200, no sag.

PART 3 EXECUTION

3.1 FORMS

- a. Provide formwork with clean-out openings to permit inspection and removal of debris. Formwork shall be gasketed or otherwise rendered sufficiently tight to prevent leakage of paste or grout under heavy, high-frequency vibration. Use a release agent that does not cause surface dusting. Limit reuse of plywood to no more than three times. Reuse may be further limited by the Contracting Officer if it is found that the pores of the plywood are clogged with paste so that the wood does not absorb air and some of the high water-cementitious materials ratio paste that may be trapped in pockets between the form and the concrete.
- b. Comply with ACI 301. Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width shall be a minimum of 4 inches greater than indicated. Set forms rigidly, mortar-tight, and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Forms submerged in water shall be watertight.
- c. Patch form tie holes with a no shrink patching material in accordance with the manufacturer's recommendations and subject to approval.

3.1.1 Coating

Before concrete placement, coat the contact surfaces of forms with a no staining mineral oil, no staining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.1.2 Removal of Forms and Supports

After placing concrete, forms shall remain in place for the time periods specified in ACI 347R, except for concrete placed underwater, forms shall remain in place a minimum of 48 hours. Prevent concrete damage during form removal.

3.1.2.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C39/C39M test results of field-cured samples from a representative portion of the structure or other approved and calibrated non-destructive testing techniques show that the concrete has reached a minimum of 85 percent of the design strength.

3.1.3 Reshoring

Do not allow construction loads to exceed the superimposed load that the structural member, with necessary supplemental support, is capable of carrying safely and without damage. Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. After forms are removed, slabs and beams over 10 feet in span and cantilevers over 4 feet shall be reshored for the remainder of the specified time period in accordance with paragraph REMOVAL OF FORMS AND SUPPORTS. Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Reshoring elements shall have the same load-carry capabilities as original shoring and shall be spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.2 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301. Remove rust, scale, oil, grease, clay, or foreign substances from reinforcing that would reduce the epoxy coating bond from reinforcing. Do not tack weld. Inspect and verify proper reinforcement grade, quantity, spacing, and clearance requirements prior to concrete placement. Inspect placed steel reinforcing for coating damage prior to placing concrete. Repair all visible damage.

3.2.1 Coated Reinforcing

If coated reinforcement is used, record coating lot on each shipping notice and carefully identify and retag bar bundles from bending plant. Provide systems for handling coated bars that have padded contact areas, nylon slings, etc., to keep bars free of dirt and grit. Carefully handle and install bars to minimize job site patching including lifting and supporting bundled coated bars with strong back, multiple supports, or platform bridge to prevent sagging and abrasion. When possible, assemble reinforcement as tied cages prior to final placement into the forms. Bundling bands shall be padded where in contact with bars. Do not drop or

drag bars or bundles. Store coated bars both in shop and in field, aboveground, on wooden or padded cribbing with adequate protective blocking between layers. Schedule deliveries of coated bars to the job site to avoid the need for long term storage. Protect from direct sunlight and weather. Bars to be stored longer than 12 hours at the job site shall be covered with opaque polyethylene sheeting or other suitable equivalent protective material.

Inspect for defects and provide required repairs prior to assembly. After assembly, reinspect and provide final repairs. Excessive nicks and scrapes that expose steel shall be cause for rejection.

- a. Immediately prior to application of the patching material, any rust and debonded coating shall be manually removed from the reinforcement by suitable techniques employing devices such as wire brushes and emery paper. Care shall be exercised during this surface preparation so that the damaged areas are not enlarged more than necessary to accomplish the repair. Damaged areas shall be clean of dirt, debris, oil, and similar materials prior to application of the patching material.
- b. Repair and patching shall be done in accordance with the patching material manufacturer's recommendations. These recommendations, including cure times, shall be available at the job site at all times.
- c. Allow adequate time for the patching materials to cure in accordance with the manufacturer's recommendation prior to concrete placement.
- d. Rinse placed reinforcing bars with ASTM C1602/C1602M compliant water to remove chloride contamination prior to placing concrete.

3.2.2 Reinforcement Supports

Place reinforcement and secure with non-corrodible chairs, spacers, and hangers. Metal hangers may be used, but shall be of similar material to the reinforcing. Support reinforcement on the ground with concrete or other non-corrodible material, having a compressive strength equal to or greater than the concrete being placed and having permeability equal or less than the concrete being placed.

Coated reinforcing bars supported from formwork shall rest on coated wire bar supports, or on bar supports made of dielectric material or other acceptable material. Wire bar supports shall be coated with dielectric material, compatible with concrete, for a minimum distance of 2 inches from the point of contact with the coated reinforcing bars. Reinforcing bars used as support bars shall be coated with the same material as the reinforcing. Spreader bars, where used, shall be coated. Non-coated combination bar clips and spreaders used in construction with coated reinforcing bars shall be made corrosion resistant or coated with dielectric material. Coated bars shall be tied with plastic-coated tie wire or other materials acceptable to the Contracting Officer.

3.2.3 Splicing

As indicated. For splices not indicated, comply with ACI 301. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches. Welded splices shall comply with AWS D1.4/D1.4M and be approved prior to use.

3.2.4 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Bolt threads shall match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.

3.2.5 Cover

Provide concrete cover thickness as shown on the Plans. If no concrete cover is specified, as a minimum, comply with ACI 318 for concrete cover over the steel reinforcement. Use ACI 117 to determine allowable tolerances for the placement of the steel.

3.2.6 Setting Miscellaneous Material and Prestress Anchorages

Place and secure anchors, bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete. Electrically isolate exposed steel work and its anchor systems from the primary steel reinforcement with at least 2 inches of concrete. Coat exposed steel work to reduce corrosion. Take particular care to ensure against corrosion on edges and horizontal surfaces. Use epoxy coatings for protection of carbon steel plates and fittings.

3.2.7 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated. Final joint locations are subject to Government approval or substantiating calculations from the Contractor.

3.2.8 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Place contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Sawed joints shall be completed within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.2.9 Waterstop Splices

Fusion weld in the field.

3.2.10 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.3 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C94/C94M, ACI 301, and ACI 304R, except as modified herein. Batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water,

2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch tickets imprinted with mix identification, batch size, batch design and measured weights, moisture in the aggregates, and time batched for each load of ready mix concrete. When a pozzolan is batched cumulatively with the cement, it shall be batched after the cement has entered the weight hopper.

3.3.1 Measuring

Make measurements at intervals as specified in paragraphs SAMPLING and TESTING.

Adjust batch proportions to replicate the mixture design using methods provided in the approved quality assurance plan. Base the adjustments on results of tests of materials at the batch plant for use in the work. Maintain a full record of adjustments and the basis for each.

3.3.2 Mixing

Comply with ASTM C94/C94M and ACI 301. If time of discharge exceeds time required by ASTM C94/C94M, submit a request along with description of precautions to be taken.

3.3.3 Transporting

Comply with ACI 304R.

3.4 PLACING CONCRETE

Comply with ACI 304R and ACI 304.2R. Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other or lifts for vertical construction. Position grade stakes on 20 foot centers maximum for exterior slabs.

3.4.1 Vibration

Comply with the requirements of ACI 309R using vibrators with a minimum frequency of 9000 vibrations per minute (VPM). Use only high cycle or high frequency vibrators. Motor-in-head 60 cycle vibrators may not be used. For walls and deep beams, use a minimum of two vibrators with the first to melt down the mixture and the second to thoroughly consolidate the mass. Provide a spare vibrator at the casting site whenever concrete is placed. Place concrete in 18 inch maximum vertical lifts. Insert and withdraw vibrators approximately 18 inches apart. Penetrate at least 8 inches into the previously placed lift with the vibrator when more than one lift is required. Extract the vibrator using a series of up and down motions to drive the trapped air out of the concrete and from between the concrete and the forms.

For slab construction, use vibrating screeds designed to consolidate the full depth of the concrete. Where beams and slabs intersect, use an internal vibrator to consolidate the beam. Do not vibrate concrete placed

with anti-washout admixtures. Vibrators shall be equipped with rubber vibrator heads.

3.4.2 Cold Weather

Comply with ACI 306R. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Placement of concrete shall be halted whenever the ambient temperature drops below 40 degrees F. When the ambient temperature is less than 50 degrees F the temperature of the concrete when placed shall be not less than 50 degrees F or more than 75 degrees F. Heating of the mixing water or aggregates may be necessary to regulate the concrete placing temperature. An accelerating admixture may be used when the ambient temperature is below 50 degrees F. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 7 days after placing, and at a temperature above freezing for the remainder of the curing period.

3.4.3 Hot Weather

Comply with ACI 305R. Maintain required concrete temperature using Figure 2.1.5, "Effect of Concrete Temperatures, Relative Humidity, and Wind Velocity on the Rate of Evaporation of Surface Moisture From Concrete" in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. If necessary, cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. If the evaporation rate exceeds 0.1 pound of water per square foot per hour, fog spray the exposed concrete surfaces until active moist curing is applied. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.4.4 Prevention of Plastic Shrinkage Cracking

During weather with low humidity, and particularly with high temperature and appreciable wind, develop and institute measures to prevent plastic shrinkage cracks from developing. If plastic shrinkage cracking occurs, halt further placement of concrete until protective measures are in place to prevent further cracking. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Figure 2.1.5 of ACI 305R. In addition to the protective measures concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, the addition of monomolecular films, or wet covering. When such water treatment is stopped, curing procedures shall be immediately commenced. The methods and materials to remove or repair areas affected by plastic shrinkage cracks shall be suggested by the Contractor, and approved by the Contracting Officer. Cracks shall never be troweled over or filled with cement slurry.

3.4.5 Depositing Concrete Under Water

ACI 301 methods and equipment used shall prevent the washing of the cement from the mixture, minimize the formation of laitance, prevent the flow of water through the concrete before it has hardened, and minimize disturbance to the previously placed concrete. Tremies, if used, shall be watertight and sufficiently large to permit a free flow of concrete. Keep the discharge end continuously submerged in fresh concrete. Keep the shaft full of concrete to a level well above the water surface. Discharge and spread the concrete by raising the tremie to maintain a uniform flow. Place concrete without interruption until the top of the fresh concrete is at the required height.

3.5 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT

3.5.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than one square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with non-shrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects that affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 347R. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise indicated.

3.5.2 Formed Surfaces

3.5.2.1 Tolerances

Comply with ACI 117 and as indicated.

3.5.2.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.5.2.3 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects that will impair the texture of the concrete surface shall not be used. Patch tie holes and defects and completely remove fins.

3.6 FINISHES FOR HORIZONTAL CONCRETE SURFACES

3.6.1 Finish

Comply with ACI 301. Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and

supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.6.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. After the concrete has been placed, consolidated, struck off, and leveled, the surface shall be roughened with stiff brushes or rakes before final set.

3.6.1.2 Floated

Exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float shall begin when the surface has stiffened sufficiently to permit the operation.

3.6.1.3 Broomed

Pier and Trestle topping slabs. Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.6.1.4 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by a burlap drag. Drag a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8 inch.

3.6.1.5 Concrete Toppings Placement

Remove dirt, laitance, and loose aggregate by means of a stiff wire broom. Keep the base wet for a period of 12 hours preceding the application of the topping. Remove excess water prior to the topping placement. Do not allow temperature differential between the completed base and the topping to exceed 10 degrees F at the time of placing. Place the topping and finish as specified for pavement.

3.7 CURING AND PROTECTION

Comply with ACI 301 and ACI 308.1 unless otherwise specified. Prevent concrete from drying by misting surface of concrete. Begin curing immediately following final set. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, by rain or running water, adverse weather conditions, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain,

flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating.

Furnish ASTM C39/C39M test results to verify the anticipated rate of strength development for the proposed concrete design mixture. Submit an increased curing period and minimum time to strip formwork based upon the reduced rate of strength development.

3.7.1 Wet Curing

Wet cure marine concrete using ASTM C1602/C1602M compliant water for a minimum of 7 days. Do not allow construction loads to exceed the superimposed load that the structural member, with necessary supplemental support, is capable of carrying in current condition safely and without damage.

Leaving the forms in place for seven days is a suitable alternative to wet curing.

3.7.1.1 Ponding or Immersion

Continually immerse the concrete throughout the seven-day curing period. Water shall not be 20 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.7.1.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.7.1.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete or over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.7.1.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and

continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.7.2 Curing Periods

Moist cure concrete using ASTM C1602/C1602M compliant water for a minimum of 7 days. Continue additional curing for a total period of 21 days. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval by the Contracting Officer.

3.8 FIELD QUALITY CONTROL

3.8.1 Fresh Concrete Properties

For each concrete mixture, the Contractor shall take samples in accordance with ASTM C172/C172M, test and record the slump, and temperature. If the slump deviates from the previous batch by more than 1 inch, air content shall also be determined. Adjustment of air content and/or slump with chemical admixture is permitted provided the water to cementitious material ratio is not exceeded.

3.8.1.1 Slump Tests

ASTM C143/C143M. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved high range water reducing (HRWR) admixture provided that the water-cementitious ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 50 cubic yards (maximum) of concrete. If concrete does not pass slump test, adjust using a HRWR and test every concrete batch until two consecutive batches meet slump without adjustment.

3.8.1.2 Temperature Tests

- a. Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions below 50 degrees F and above 80 degrees F for each batch (minimum) or every 50 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.
- b. Determine temperature of each concrete sample in accordance with ASTM C1064/C1064M. Temperatures must comply with the Concrete Temperature Control Plans.

3.8.1.3 Air Content Tests

ASTM C231/C231M or ASTM C173/C173M. Perform tests at commencement of concrete placement each day, when test cylinders are made, and if slump test varies by more than 1 inch from previous results or concrete does not pass slump test.

3.8.1.4 Unit Weight Test

ASTM C138/C138M. Take concrete samples during concrete placement. Perform tests at commencement of concrete placement, when test cylinders

are made, and for each batch (minimum) or every 50 cubic yards(maximum) of concrete.

3.8.2 Hardened Concrete Properties

Sample and test each lot at or before 100 cubic yards for the first 500 cubic yards.

Cast and cure specimens in accordance with ASTM C172/C172M, ASTM C31/C31M, and applicable requirements of ACI 305R and ACI 306R.

For each lot, record the date and time sampled, the batch ticket code, cylinder ID code the location of placement, total volume of concrete represented by the sample, and fresh concrete properties; ASTM C143/C143M for slump or ASTM C1611/C1611M for slump flow and visual stability index (VSI), ASTM C231/C231M for air content, ASTM C1064/C1064M for temperature, and ASTM C138/C138M unit weight.

For each lot sample, cast seven 6 by 12 inch cylinder specimens for strength and three 4 by 8 inch cylinder specimens for chloride ion penetration testing. These cylinders shall be wrapped completely with slightly dampened paper towels with water only. The wrapped cylinders shall be placed in either a vacuum package or double layers of sealed plastic bags. Package cylinders to prevent damage and ship to the approved testing laboratory.

In the event quality acceptance test results and retest results fail to meet the quality acceptance criteria, the entire lot shall be considered non-conforming material, refer to the paragraph REPAIR, REHABILITATION and REMOVAL.

3.8.2.1 Compressive Strength Tests

ACI 214R tests for strength - conduct strength tests of concrete during construction in accordance with the following procedures:

- a. Test cylinders in accordance with ASTM C39/C39M. Test two cylinders at 3 days, two cylinders at 7 days, and two cylinders at the age when the compressive strength requirement was specified. Hold the remaining cylinder in storage. If one specimen in a test shows evidence of improper sampling, molding or testing, discard the specimen and consider the strength of the remaining cylinder to be the test result. If more than one specimen shows excess defects, the Contracting Officer may allow the entire test to be discarded. Test results shall not exceed the specified compressive strength by more than 20 percent for the age specified.
- b. If the average strength test results are less than the specified strength (f'_c) extract three core samples from the structure in accordance with ASTM C42/C42M, from the area that correlates to the low test results. These extracted cores shall not contain steel reinforcing. Repair core holes with non-shrink grout. Match color and finish of adjacent concrete. For concrete not meeting strength criteria, the Contractor shall prepare a remediation strategy for the review by the Contracting Officer.
- c. Strength test reports shall be provided within 7 days of test completion.

3.8.2.2 Chloride Ion Penetration Test

Test cylinder concrete for chloride ion penetration at 56 days. Concrete representative of the tested concrete with values greater than the quality acceptance values determined in Table 1, will require retesting using spare samples. If the retest exceeds the quality acceptance limit, this shall be grounds to stop concrete placement and to review quality control issues.

3.8.2.3 Chloride Ion Concentration

Comply with Table 1. Determine water soluble chloride ion concentration. Perform test once for each mix design.

3.8.2.4 Anti-Washout Admixture

Comply with COE CRD-C 61. Determine cumulative mass loss. Perform test once for each 350 cubic yards of underwater concrete.

3.8.2.5 Non-Destructive Tests

Contracting Officer must specifically allow the use of a rebound hammer to obtain data on the strength of the concrete surface shall be in accordance with ASTM C805/C805M. Test results from the rebound hammer and other non-destructive testing may be helpful in selecting areas to extract concrete cores for destructive testing.

3.8.3 Core Samples and Compressive Strength Testing

Obtain and test cores in accordance with ASTM C42/C42M.

If concrete in the structure is dry under service conditions, air dry cores (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for 7 days before testing and test dry. Otherwise, test the cores, after moisture conditioning, in accordance with ASTM C42/C42M.

Acceptance criteria for cylinder compressive strength are provided in paragraph ACCEPTANCE OF CONCRETE STRENGTH.

Take at least three representative cores from each member or area of concrete in place that is considered potentially strength deficient. Impair the strength of the structure as little as possible. If, before testing, extracted cores show evidence of having been damaged subsequent to or during removal from the structure, take replacement cores.

Fill core holes with low slump concrete or mortar of a strength equal to or greater than the original concrete.

The Contracting Officer will evaluate and validate core tests in accordance with the specified procedures.

3.8.4 Acceptance of Concrete Strength

3.8.4.1 Standard Molded and Cured Strength Specimens

The acceptance of concrete strengths shall be based on averages of results from three consecutive compressive strength tests. When the averages of all sets of three consecutive compressive strength test results are between 1.0 and 1.2 times the field test strength (fcr), and no individual

strength test falls below fcr by more than 500 psi, the strength of the concrete is satisfactory. These criteria also apply when accelerated strength testing is specified unless another basis for acceptance is specified.

3.8.4.2 Non-Destructive Tests

Non-destructive tests may be used when permitted to evaluate concrete where standard molded and cured cylinders have yielded results not meeting the criteria.

3.8.4.3 Extracted Core Tests

When the average compressive strengths of the representative cores are between 0.85 fcr and 1.2 fcr and if no single core is less than 0.75 fcr, the strength of concrete is satisfactory.

3.8.5 Inspection

ACI 311.4R. Inspect concrete placed under water with qualified divers.

3.9 REPAIR, REHABILITATION AND REMOVAL

Before the Contracting Officer accepts the structure and final payment is made the Contractor shall inspect the structure for cracks, damage, and substandard concrete placements that may adversely affect the service life of the structure. A report documenting these defects shall be prepared that includes recommendations for repair, removal and/or remediation which, will be reviewed by the agency's Subject Matter Expert in Concrete Materials and submitted to the Contracting Officer for approval before any corrective work is accomplished.

3.9.1 Crack Repair

Prior to final acceptance, all cracks in excess of 0.02 inches wide shall be documented and repaired. The proposed method and materials to repair the cracks shall be submitted to the Contracting Officer for approval. The proposal shall address the amount of movement expected in the crack due to temperature changes and loading.

3.9.2 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Concrete surfaces with weak surfaces less than 1/4 inch thick shall be diamond ground to remove the weak surface. Surfaces containing weak surfaces greater than 1/4 inch thick shall be removed and replaced or mitigated in a manner acceptable to the Contracting Officer.

3.9.3 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor to restore the original design intent shall be reviewed by the agency's Subject Matter Expert in Concrete Materials and approved by the Contracting Officer prior to proceeding.

-- End of Section --

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SECTION 03 42 13.00 10

PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION
05/16

PART 1 GENERAL

1.1 SUMMARY OF WORK

The work under this section consists of all precast concrete structures for the sanitary and drainage collection systems for the NOAA OMAO Ship & Support Facility Relocation project at Naval Station Newport, RI. The Contractor shall furnish all materials, labor, equipment, utilities, and incidental items necessary to provide sanitary and drainage precast concrete structures as indicated on the project drawings and specified herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 211.2	(1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102	(2000) Concrete Pipe Handbook
ACPA 01-110	(1984) Design Manual for Sulfide and Corrosion Prediction and Control
ACPA QPC	(2020) QCast Plant Certification Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel
AWS D1.4/D1.4M	(2011) Structural Welding Code -

Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2016) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2017) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A884/A884M	(2019) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2019a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39/C39M	(2020) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C138/C138M	(2017a) Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C171	(2016) Standard Specification for Sheet Materials for Curing Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	(2019) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C443	(2020) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C857	(2016) Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM C858	(2010; E 2012) Standard Specification for Underground Precast Concrete Utility Structures
ASTM C877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C891	(2019) Installation of Underground Precast Concrete Utility Structures
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C923	(2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C990	(2009; R 2014) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1064/C1064M	(2017) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1116/C1116M	(2010a; R 2015) Standard Specification for Fiber-Reinforced Concrete
ASTM C1244	(2011; R 2017) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM C1478	(2019) Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals

CSA GROUP (CSA)

CSA A23.4 (2016; Errata 2016) Precast Concrete -
Materials and Construction

NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)

NPCA QC Manual (2017) Quality Control Manual for Precast
and Prestressed Concrete Plants

1.3 SUBMITTALS

All submittals are the responsibility of the precast concrete producer. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Procedures

SD-02 Shop Drawings

Standard Precast Units; G
Custom-Made Precast Units; G
Special Finishes

SD-03 Product Data

Standard Precast Units
Proprietary Precast Units
Embedded Items
Accessories

SD-05 Design Data

Design Calculations; G
Concrete Mix Proportions

SD-06 Test Reports

Test Reports

SD-07 Certificates

Quality Control Procedures

SD-11 Closeout Submittals

Recycled content for fly ash and pozzolan; S
Recycled content for Ground Iron Blast-Furnace Slag; S
Recycled content for Silica Fume; S
Recycled content for Synthetic Fiber Reinforcement; S
Recycled content for steel; S

1.4 QUALITY ASSURANCE

Demonstrate adherence to the standards set forth in NPCA QC Manual or ACPA QPC. Meet requirements written in the subparagraphs below.

1.4.1 NPCA and ACPA Plant Certification

The precast concrete producer must be certified by the National Precast Concrete Association's or the American Concrete Pipe Association's Plant Certification Program prior to and during production of the products for this project.

1.4.2 Qualifications, Quality Control and Inspection

1.4.2.1 Qualifications

Select a precast concrete producer that has been in the business of producing precast concrete units similar to those specified for a minimum of 3 years. The precast concrete producer must maintain a permanent quality control department or retain an independent testing agency on a continuing basis.

1.4.2.2 Quality Control Procedures

Submit quality control procedures established by the precast manufacturer in accordance with NPCA QC Manual and ACPA QPC. Show that the following QC tests are performed as required and in accordance with the ASTM standards indicated.

1.4.2.2.1 Slump

Perform a slump test for each 150 cu yd of concrete produced, or once a day, whichever comes first. Perform slump tests in accordance with ASTM C143/C143M.

1.4.2.2.2 Temperature

Measure the temperature of fresh concrete when slump or air content tests are made and when compressive test specimens are made in accordance with ASTM C1064/C1064M.

1.4.2.2.3 Compressive Strength

Make at least four compressive strength specimens for each 150 cubic yards of concrete of each mix in accordance with the following Standards: ASTM C31/C31M, ASTM C192/C192M, ASTM C39/C39M.

1.4.2.2.4 Air Content

Perform tests for air content on air-entrained, wet-cast concrete for each 150 cu yd of concrete, but not less often than once each day when air-entrained concrete is used. Determine the air content in accordance with either ASTM C231/C231M or ASTM C173/C173M for normal weight aggregates and ASTM C173/C173M for lightweight aggregates.

1.4.2.2.5 Unit Weight

Perform tests for unit weight a minimum of once per week to verify the yield of batch mixes. Perform unit weight tests for each 100 cu yd of

lightweight concrete in accordance with ASTM C138/C138M.

1.4.2.3 Inspection

The Contracting Officer may place an inspector in the plant when the units covered by this specification are being manufactured. The burden of payment for plant inspection will be clearly detailed in the specification. The precast concrete producer must give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.4.2.4 Test Reports

Submit the following:

1.4.2.4.1 Material Certifications or Laboratory Test Reports

Include mill tests and all other test data, for portland cement, blended cement, pozzolans, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

1.4.2.4.2 Mix Test

Submit reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze thaw durability, abrasion and absorption. Clearly detail in the specifications special tests for precast concrete or cast-in items.

1.4.2.4.3 Self-Consolidating Concrete

Submit sufficient documentation, when the use of self-consolidating concrete (SCC) is proposed, showing a minimum of 30-days production track records demonstrating that SCC is appropriate for casting of the product.

1.4.2.4.4 In-Plant QA/QC Inspection Reports

Submit inspection reports upon the request of the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver precast units to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite, all precast concrete units will be inspected by the Contracting Officer for quality and final acceptance.

1.5.2 Storage

Store units off the ground or in a manner that minimizes potential damage.

1.5.3 Handling

Handle, transport, and store products in a manner to minimize damage.

Lifting devices or holes must be consistent with industry standards. Perform lifting with methods or devices intended for this purpose as indicated on shop drawings.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Furnish precast concrete units designed and fabricated by an experienced and acceptable precast concrete manufacturer who has been, for at least three years, regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings. Coordinate precast work with the work of other trades. Below grade structures must comply with ASTM C858.

2.1.1 Standard Precast Units

Design standard precast concrete units to withstand indicated design load conditions in accordance with applicable industry design standards ACI 318, ASTM C857. Design must also consider stresses induced during handling, shipping and installation as to avoid product cracking or other handling damage. Indicate design loads for precast concrete units on the shop drawings. Submit drawings for standard precast concrete units furnished by the precast concrete producer for approval by the Contracting Officer. These drawings must demonstrate that the applicable industry design standards have been met. Include installation and construction information on shop drawings. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings. Submit cut sheets, for standard precast concrete units, showing conformance to project drawings and requirements, and to applicable industry design standards listed in this specification.

2.1.2 Custom-Made Precast Units

Submit design calculations for custom-made precast units, prepared and sealed by a registered professional engineer, for approval prior to fabrication. Include in the calculations the analysis of units for lifting stresses and the sizing of lifting devices. Submit drawings furnished by the precast concrete producer for approval by the Contracting Officer. Show on these drawings complete design, installation, and construction information in such detail as to enable the Contracting Officer to determine the adequacy of the proposed units for the intended purpose. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings.

2.1.3 Proprietary Precast Units

Products manufactured under franchise arrangements must conform to all the requirements specified by the franchiser. Items not included in the franchise specification, but included in this specification, must conform to the requirements in this specification. Submit standard plans or informative literature, for proprietary precast concrete units. Make available supporting calculations and design details upon request. Provide sufficient information as to demonstrate that such products will perform the intended task.

2.1.4 Joints and Sealants

Provide joints and sealants between adjacent units of the type and configuration indicated on shop drawings meeting specified design and performance requirements.

2.1.5 Concrete Mix Design

2.1.5.1 Concrete Mix Proportions

Base selection of proportions for concrete on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. Develop the concrete proportions using the same type and brand of cement, the same type and brand of pozzolan, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Do not use calcium chloride in precast concrete containing reinforcing steel or other embedded metal items. At a minimum of thirty days prior to precast concrete unit manufacturing, the precast concrete producer will submit a mix design and proportions for each strength and type of concrete that will be used. Furnish a complete list of materials, including quantity, type, brand and applicable data sheets for all mix design constituents as well as applicable reference specifications. The use of self-consolidating concrete is permitted, provided that mix design proportions and constituents meet the requirements of this specification.

2.1.5.2 Concrete Strength

Provide precast concrete units with a 28-day compressive strength (f'_c) of 5000 psi.

2.1.5.3 Water-to-Cement Ratio

Where exposed to freezing and thawing, furnish concrete containing entrained air and with a water-cementitious ratio of 0.45 or less. Where not exposed to freezing, but required to have a low permeability, furnish concrete with a water-cementitious ratio of 0.48 or less. Where exposed to deicer salts, brackish water, or seawater, furnish concrete with a water-cementitious ratio of 0.40 or less, for corrosion protection.

2.1.5.4 Air Content

The air content of concrete that will be exposed to freezing conditions must be within the limits given below.

NOMINAL MAXIMUM AGGREGATE SIZE	AIR CONTENT PERCENT	
	EXPOSURE CLASS F1	EXPOSURE CLASSES F2 and F3
3/8 inch	6.0	7.5
1/2 inch	5.5	7.0
3/4 inch	5.0	6.0

NOMINAL MAXIMUM AGGREGATE SIZE	AIR CONTENT PERCENT	
	EXPOSURE CLASS F1	EXPOSURE CLASSES F2 and F3
1.0 inch	4.5	6.0
1.5 inch	4.5	5.5
Note: For specified compressive strengths greater than 5000 psi, air content may be reduced 1 percent		

2.1.5.5 Corrosion Control for Sanitary Sewer Systems

Follow design recommendations outlined in Chapter 7 of ACPA 01-102 or the ACPA 01-110 when hydrogen sulfide is indicated as a potential problem.

2.2 MATERIALS

Except as otherwise specified in the following paragraphs, conform material to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.2.1 Material Sustainability Criteria

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS:

- a. Recycled content for fly ash and pozzolan
- b. Recycled content for Ground Iron Blast-Furnace Slag
- c. Recycled content for Silica Fume
- d. Recycled content for Synthetic Fiber Reinforcement
- e. Recycled content for steel, 75 percent minimum

2.2.2 Pigments

Non-fading and lime-resistant

2.2.3 Reinforcement

2.2.3.1 Reinforcing Bars

- a. Deformed Billet-steel: ASTM A615/A615M
- b. Deformed Low-alloy steel: ASTM A706/A706M

2.2.3.2 Reinforcing Wire

- a. Plain Wire: ASTM A1064/A1064M
- b. Deformed Wire: ASTM A1064/A1064M

2.2.3.3 Welded Wire Reinforcement

- a. Plain Wire: ASTM A1064/A1064M
- b. Deformed Wire: ASTM A1064/A1064M

2.2.3.4 Epoxy Coated Reinforcement

- a. Reinforcing Bars: ASTM A775/A775M
- b. Wires and Welded Wire: ASTM A884/A884M

2.2.3.5 Galvanized Reinforcement

Provide galvanized reinforcement conforming to ASTM A767/A767M.

2.2.4 Synthetic Fiber Reinforcement

Provide fiber reinforced concrete in accordance with ASTM C1116/C1116M Type III, synthetic fiber reinforced concrete, and as follows. Synthetic reinforcing fibers must be monofilament polypropylene fibers, with a minimum of 10 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. Provide fibers that have a specific gravity of 0.9, a minimum tensile strength of 70 ksi, graded per manufacturer, and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement.

2.2.5 Inserts and Embedded Metal

All items embedded in concrete must be of the type required for the intended task, and meet the following standards.

- a. Structural Steel Plates, Angles, etc.: ASTM A36/A36M
- b. Hot-dipped Galvanized: ASTM A153/A153M
- c. Proprietary Items: In accordance with manufacturers published literature

2.2.6 Accessories

Submit proper installation instructions and relevant product data for items including, but not limited to, sealants, gaskets, connectors, steps, cable racks and other items installed before or after delivery.

- a. Rubber Gaskets for Circular Concrete Sewer Pipe and Culvert Pipe: ASTM C443.
- b. External Sealing Bands for Noncircular Sewer, Storm Drain and Culvert Pipe: ASTM C877.
- c. Preformed Flexible Joint Sealants for Concrete Pipe, Manholes, and Manufactured Box Sections: ASTM C990.
- d. Elastomeric Joint Sealants: ASTM C920

2.2.7 Pipe Entry Connectors

Pipe entry connectors must conform to ASTM C923 or ASTM C1478.

2.2.8 Grout

Nonshrink Grout must conform to ASTM C1107/C1107M. Cementitious grout must be a mixture of portland cement, sand, and water. Proportion one

part cement to approximately 2.5 parts sand, with the amount of water based on placement method.

PART 3 EXECUTION

3.1 FABRICATION AND PLACEMENT

Perform fabrication in accordance with NPCA QC Manual or ACPA QPC unless specified otherwise.

3.1.1 Forms

Use forms, for manufacturing precast concrete products, of the type and design consistent with industry standards and practices. They should be capable of consistently providing uniform products and dimensions. Construct forms so that the forces and vibrations to which the forms will be subjected can cause no product damage. Clean forms of concrete build-up after each use. Apply form release agents according to the manufacturers recommendations and do not allow to build up on the form casting surfaces.

3.1.2 Reinforcement

Follow applicable ASTM Standard or ACI 318 for placement and splicing. Fabricate cages of reinforcement either by tying the bars, wires or welded wire reinforcement into rigid assemblies or by welding, where permissible, in accordance with AWS D1.4/D1.4M. Position reinforcing as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover must be one-third of that specified but not more than 1/2 inch. Provide concrete cover not less than 1/2 inch. Take positive means to assure that the reinforcement does not move significantly during the casting operations.

3.1.3 Embedded Items

Position embedded items at locations specified in the design documents. Perform welding in accordance with AWS D1.1/D1.1M when necessary. Hold rigidly in place inserts, plates, weldments, lifting devices and other items to be imbedded in precast concrete products so that they do not move significantly during casting operations. Submit product data sheets and proper installation instruction for anchors, lifting inserts and other devices. Clearly indicate the products dimensions and safe working load.

3.1.4 Synthetic Fiber Reinforced Concrete

Add fiber reinforcement to the concrete mix at the batch plant in accordance with the applicable sections of ASTM C1116/C1116M and the recommendations of the manufacturer. Use a minimum of 1.5 pounds of fibers per cubic yard of concrete.

3.2 CONCRETE

3.2.1 Concrete Mixing

Mixing operations must produce batch-to-batch uniformity of strength, consistency, and appearance.

3.2.2 Concrete Placing

Deposit concrete into forms as near to its final location as practical. Keep the free fall of the concrete to a minimum. Consolidate concrete in such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Use vibrators to consolidate concrete with frequencies and amplitudes sufficient to produce well consolidated concrete.

3.2.2.1 Cold Weather Concreting

Perform cold weather concreting in accordance with ACI 306.1.

- a. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather.
- b. All concrete materials, reinforcement, forms, fillers, and ground with which concrete is to come in contact must be free from frost.
- c. Do not use frozen materials or materials containing ice.
- d. In cold weather the temperature of concrete at the time of placing must not be below 45 degrees F. Discard concrete that freezes before its compressive strength reaches 500 psi.

3.2.2.2 Hot Weather Concreting

Follow recommendations for hot weather concreting in ACI 305R. During hot weather, give proper attention to constituents, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure. The temperature of concrete at the time of placing must not exceed 90 degrees F.

3.2.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing.

3.2.3.1 Curing by Moisture Retention

Prevent moisture evaporation from exposed surfaces until adequate strength for stripping is reached by one of the following methods:

- a. Cover with polyethylene sheets a minimum of 6 mils thick in accordance with ASTM C171.
- b. Cover with burlap or other absorptive material and keep continually moist.
- c. Use a membrane-curing compound, conforming to ASTM C309 and applied at a rate not less than 200 square ft/gallon, or in accordance with manufacturers' recommendations.

3.2.3.2 Curing with Heat and Moisture

Do not subject concrete to steam or hot air until after the concrete has attained its initial set. Apply steam, if used, within a suitable enclosure, which permits free circulation of the steam in accordance with

CSA A23.4. If hot air is used for curing, take precautions to prevent moisture loss from the concrete. The temperature of the concrete must not be permitted to exceed 150 degrees F. These requirements do not apply to products cured with steam under pressure in an autoclave.

3.2.4 Surface Finish

Finish unformed surfaces of wet-cast precast concrete products as specified. If no finishing procedure is specified, finish such surfaces using a strike-off to level the concrete with the top of the form.

3.2.4.1 Formed Non-Architectural Surfaces

Cast surfaces against approved forms following industry practices in cleaning forms, designing concrete mixes, placing and curing concrete. Normal color variations, form joint marks, small surface holes caused by air bubbles, and minor chips and spalls will be accepted but no major imperfections, honeycombs or other major defects will be permitted.

3.2.4.2 Unformed Surfaces

Finish unformed surfaces with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be accepted. Major imperfections, honeycombs, or other major defects are not permitted.

3.2.4.3 Special Finishes

Troweled, broom or other finishes must be according to the requirements of project documents and performed in accordance with industry standards or supplier specifications. Submit finishes for approval when required by the project documents. The sample finishes must be approved prior to the start of production.

3.2.5 Stripping Products from Forms

Do not remove products from the forms until the concrete reaches the compressive strength for stripping required by the design. If no such requirement exists, products may be removed from the forms after the final set of concrete provided that stripping damage is minimal.

3.2.6 Patching and Repair

No repair is required to formed surfaces that are relatively free of air voids and honeycombed areas, unless the surfaces are required by the design to be finished.

3.2.6.1 Repairing Minor Defects

Defects that will not impair the functional use or expected life of a precast concrete product may be repaired by any method that does not impair the product.

3.2.6.2 Repairing Honeycombed Areas

When honeycombed areas are to be repaired, remove all loose material and cut back the areas into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Use proprietary repair materials in accordance with the

manufacturer's instructions. If a proprietary repair material is not used, saturate the area with water. Immediately prior to repair, the area should be damp, but free of excess water. Apply a cement-sand grout or an approved bonding agent to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.

3.2.6.3 Repairing Major Defects

Evaluate, by qualified personnel, defects in precast concrete products which impair the functional use or the expected life of products to determine if repairs are feasible and, if so, to establish the repair procedure.

3.2.7 Shipping Products

Do not ship products until they are at least five days old, unless it can be shown that the concrete strength has reached at least 75 percent of the specified 28-day strength, or that damage will not result, impairing the performance of the product.

3.3 INSTALLATION

3.3.1 Site Access

It is the Contractor's responsibility to provide adequate access to the site to facilitate hauling, storage and proper handling of the precast concrete products.

3.3.2 General Requirements

- a. Install precast concrete products to the lines and grades shown in the contract documents or otherwise specified.
- b. Lift products by suitable lifting devices at points provided by the precast concrete producer.
- c. Install products in accordance with the precast concrete producer's instructions. In the absence of such instructions, install underground utility structures in accordance with ASTM C891. Install pipe and manhole sections in accordance with the procedures outlined by the American Concrete Pipe Association.
- d. Field modifications to the product will relieve the precast producer of liability even if such modifications result in the failure of the product.

3.3.3 Water Tightness

Where water tightness is a necessary performance characteristic of the precast concrete product's end use, watertight joints, connectors and inserts should be used to ensure the integrity of the entire system.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Tests

When water tightness testing is required for an underground product, use one of the following methods:

3.4.2 Vacuum Testing

Prior to backfill vacuum test system according to ASTM C1244.

3.4.3 Water Testing

Perform water testing according to the contract documents and precast concrete producer's recommendations.

-- End of Section --

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SECTION 03 45 33

PRECAST PRESTRESSED STRUCTURAL CONCRETE
05/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO LRFDCONS (3rd Edition; 2010, 2011, 2012, 2014, 2015, and 2016 Int) Bridge Construction Specifications

AASHTO M 251 (2006; R 2020) Standard Specification for Plain and Laminated Elastomeric Bridge Bearings

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 301 (2016) Specifications for Structural Concrete

ACI 318 (2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding Code - Steel

AWS D1.4/D1.4M (2018) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A27/A27M (2020) Standard Specification for Steel Castings, Carbon, for General Application

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

ASTM A47/A47M (1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings

ASTM A108 (2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

ASTM A123/A123M (2017) Standard Specification for Zinc

	(Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A416/A416M	(2018) Standard Specification for Low-Relaxation, Seven-Wire for Prestressed Concrete
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A572/A572M	(2021; E 2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2019) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(2020) Standard Specification for Structural Steel Shapes
ASTM A1064/A1064M	(2018a) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM C150/C150M	(2021) Standard Specification for Portland Cement
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C295/C295M	(2019) Standard Guide for Petrographic Examination of Aggregates for Concrete

ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1017/C1017M	(2013; E 2015) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1202	(2019) Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
ASTM C1218/C1218M	(2020c) Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C1260	(2021) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1567	(2021) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2018) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness
ASTM F436	(2011) Hardened Steel Washers
ASTM F844	(2019) Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	(2015) Quality Management Systems-
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Requirements

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1999) Manual for Quality Control for Plants and Production of Structural Precast Concrete Products, 4th Edition
PCI MNL-120	(2021) PCI Design Handbook - Precast and Prestressed Concrete, 8th Edition
PCI MNL-135	(2000) Tolerance Manual for Precast and Prestressed Concrete Construction

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-882	(1989; Rev E) Cloth, Duck, Cotton or Cotton-Polyester Blend, Synthetic Rubber, Impregnated, and Laminated, Oil Resistant
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1.2 MODIFICATION TO REFERENCE

In the ACI publications, reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" must be interpreted to mean the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

1.3.1 Coordinated Submittal Review

Concrete mix design, supporting product data, and supporting test report submittals for this Section shall be submitted concurrently as one submittal package for review with the mix design.

SD-02 Shop Drawings

Drawings of Precast Prestressed Concrete Members; G

SD-03 Product Data

Anchorage and Lifting Inserts and devices; G

Bearing Pads; G

SD-05 Design Data

Precast Prestressed Concrete Members Handling Calculations; G

Concrete Mix Design; G

SD-06 Test Reports

Concrete Mix Design; G

Fly Ash

Ground Granulated Blast-Furnace Slag

Aggregates

Concrete and Aggregate Quality Control Testing

Water

SD-07 Certificates

Quality Control Procedures

Construction Records; G

SD-11 Closeout Submittals

Concrete Batch Ticket Information

Recycled Content for Fly Ash and Pozzolan; S

Recycled Content for Ground Iron Blast-Furnace Slag; S

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Manufacturer Qualifications

PCI MNL-116. Plants must be certified by the PCI Plant Certification Program for Category C3 work. At the Contracting Officer's option, PCI Plant quality control program records must be available for review.

PCI MNL-116. Where panels are manufactured by specialists in plants not currently enrolled in the PCI "Quality Control Program," provide a product quality control system in accordance with PCI MNL-116 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory. Submit test results to the Contracting Officer.

1.4.1.2 Welding Qualifications

Provide AWS D1.1/D1.1M qualified welders who are currently certified at contract award date and have maintained their certificates over the past year.

1.4.2 Regulatory Requirements

Provide precast prestressed members in conformance with ACI 318 and PCI MNL-120.

1.4.3 Concrete Mix Design

ACI 318. The minimum compressive strength of concrete at 28 days must be 5000 psi, unless otherwise indicated. Add air-entraining admixtures at the mixer to produce between 4 and 6 percent air by volume. For marine exposure, ensure a dense concrete free of shrinkage cracks, with a minimum degree of permeability. The maximum water cement ratio must be 0.40.

Sixty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, complementary cementitious materials, and admixtures; and applicable reference specifications. Submit mill test and all other test for cement, complementary cementitious materials, aggregates, and admixtures. Provide documentation of maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Resubmit data on concrete components if the qualities or source of components changes. For previously approved concrete mix designs used within the past twelve months, the previous mix design may be re-submitted without further trial batch testing if accompanied by material test data conducted within the last six months. Obtain mix design approval from the contracting officer prior to concrete placement.

1.4.4 Certificates: Record Requirement

ASTM C94/C94M. Submit mandatory batch ticket information for each load of ready-mixed concrete.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Transportation

1.5.1.1 Transporting Members

Transport members in a manner to avoid excessive stresses that could cause cracking or other damage.

1.5.1.2 Lateral Deflection or Vibration

Any noticeable indication of lateral deflection or vibration during transportation must be corrected by rigid bracing between members or by means of lateral trussing.

1.5.2 Storage

1.5.2.1 Storage Areas

Storage areas for precast prestressed members must be stabilized, and suitable foundations must be provided, so differential settlement or twisting of members will not occur.

1.5.2.2 Stacked Members

Stack members with adequate dunnage and bracing to control cracking, distortion, warping or other physical damage. Stack members such that lifting devices will be accessible and undamaged.

1.5.3 Handling of Members

The location of pickup points for handling of the members and details of the pickup devices must be shown in shop drawings. Members must be handled only by means of approved devices at designated locations. Members must be maintained in an upright position at all times and picked up and supported as shown in approved shop drawings.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

The work includes the provision of precast, prestressed concrete herein referred to as prestressed members. Prestressed members must be the product of a manufacturer specializing in the production of prestressed concrete members.

2.1.1 Design Requirements

Design prestressed members in accordance with ACI 318 and the PCI MNL-120. Design precast prestressed members for handling and erection stresses, and for additional loads imposed by openings. Design prestressed members for handling without cracking in accordance with the PCI MNL-120.

2.1.1.1 Loads

Loadings for members and connections must include all dead load, , applicable construction loads such as handling, and erection loads.

2.1.1.2 Drawing and Design Calculation Information

Submit drawings indicating complete information for the fabrication, handling, and erection of the precast, prestressed member. Include a cover page with the design calculations, signed and sealed by the registered design professional who prepared the handling calculations. Drawings of prestressed members must be prepared by an experienced precast, prestressed concrete detailer and submitted for approval prior to fabrication. Drawings must not be reproductions of contract drawings. Handling calculations and drawings of precast prestressed concrete members must be made by a registered professional engineer experienced in the design of precast prestressed concrete members, and submitted for approval prior to fabrication. The drawings must indicate, as a minimum, the following information:

a. Plans, elevations and other drawing views showing the following:

- (1) Member piece marks locating and defining products furnished by the manufacturer.
- (2) Location and size of all openings that cut prestressing strands or require the location of prestressing strands to miss field cut openings.
- (3) Relationships to adjacent material.
- (4) Joints and openings between members and between members and other construction.
- (5) Location of field installed anchors.

(6) Erection sequences and handling requirements

(7) Lifting and erection inserts

b. Elevations, sections and other details for each member showing the following:

(1) Connections between members and connections between members and other construction.

(2) Connections for work of other trades and cast-in items and their relation to other trades.

(3) Dimensioned size and shape for each member with quantities, position and other details of reinforcing steel, anchors, inserts and other embedded items.

(4) Lifting, erection and other handling devices and inserts.

(5) Surface finishes of each member.

(6) Estimated cambers

c. Magnitude, schedule and sequence of tensioning and detensioning prestressing strands.

d. Strength properties for concrete, steel and other materials.

e. Methods for storage and transportation.

f. Description of loose, cast-in and field hardware.

g. All dead, live, handling, erection and other applicable loads used in the design.

h. Signature and seal of the registered design professional who prepared the handling and erection calculations.

2.2 MATERIALS

2.2.1 Material Sustainability Criteria

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING:

a. Recycled content for fly ash and pozzolan

b. Recycled content for Ground Iron Blast-Furnace Slag

2.2.2 Cementitious Materials

For exposed concrete, use one manufacturer and one source for each type of cement, ground slag, and fly ash.

2.2.2.1 Fly Ash

ASTM C618, Class F, including the optional requirements for uniformity and

effectiveness in controlling Alkali-Silica reaction and must have a loss on ignition must not exceed 6 percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 8 percent and a total equivalent alkali content less than 1.5 percent. Add with cement.

2.2.2.2 Ground Granulated Blast-Furnace Slag

ASTM C989/C989M, Grade 120. Add with cement.

2.2.2.3 Silica Fume

Silica fume is not permitted.

2.2.2.4 Portland Cement

Provide cement that conforms to ASTM C150/C150M, Type I/II, low alkali with tri-calcium aluminates (C3A) content less than 10 percent and a maximum cement-alkali content of 0.80 percent Na₂O_e (sodium oxide) equivalent. Type III cement shall not be used. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.2.2.5 Supplementary Cementitious Materials (SCM) Content

The concrete mix shall always contain supplementary cementing materials whether or not the aggregates are found to be reactive in accordance with the paragraph AGGREGATES. Concrete mixtures shall be designed and proportioned to meet the requirements for strength, constructability, shrinkage, and durability.

2.2.3 Water

Water must comply with the requirements of ASTM C1602/C1602M. Minimize the amount of water in the mix. Improve workability by adjusting the grading rather than by adding water. Water must be potable, free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete. Submit test report showing water complies with ASTM C1602/C1602M.

2.2.4 Aggregates

ASTM C33/C33M, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Provide aggregates that do not contain any substance which may be deleteriously reactive with the alkalis in the cement. Submit test report showing compliance with ASTM C33/C33M.

Fine and coarse aggregates must show expansions less than 0.08 percent at 28 days after casting when testing in accordance with ASTM C1260. Should the test data indicate an expansion of 0.08 percent or greater, reject the aggregate(s) or perform additional testing using ASTM C1567 using the Contractor's proposed mix design. In this case, include the mix design low alkali portland cement and one of the following supplementary cementitious materials:

- a. GGBF slag at a minimum of 40 percent of total cementitious
- b. Fly ash or natural pozzolan at a minimum of total cementitious of

- (1) 30 percent if (SiO₂ plus Al₂O₃ plus Fe₂O₃) is 65 percent or more,
- (2) 25 percent if (SiO₂ plus Al₂O₃ plus Fe₂O₃) is 70 percent or more,
- (3) 20 percent if (SiO₂ plus Al₂O₃ plus Fe₂O₃) is 80 percent or more,

If a combination of these materials is chosen, the minimum amount must be a linear combination of the minimum amounts above. Include these materials in sufficient proportion to show less than 0.08 percent expansion at 28 days after casting when tested in accordance with ASTM C1567.

Aggregates must not possess properties or constituents that are known to have specific unfavorable effects in concrete when tested in accordance with ASTM C295/C295M.

2.2.5 Grout

2.2.5.1 Nonshrink Grout

ASTM C1107/C1107M.

2.2.5.2 Cementitious Grout

Must be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

2.2.6 Admixtures

Provide chemical admixtures that comply with the requirements shown below and in accordance with manufacturer's recommendations, and appropriate for the climatic conditions and the construction needs. Do not use calcium chloride or admixtures containing chlorides from other than impurities from admixture ingredients.

2.2.6.1 Air-Entraining

ASTM C260/C260M.

2.2.6.2 Accelerating

ASTM C494/C494M, Type C or E.

2.2.6.3 Corrosion Inhibitors

Corrosion inhibitors are considered "supplemental corrosion protection". Corrosion inhibitor must be at least a 30 percent water solution of calcium nitrate (CNI). Accelerating and set adjusted versions are acceptable, however, the concrete set time effects and mixture workability shall be considered. Refer to admixture manufacturer recommendations for dosage for chloride protection levels. A minimum of 2.0 gallons per cubic yard of corrosion inhibitor must be used in the concrete mix for the precast concrete, adjust the quantity of concrete mixing water for the mass of water in the admixture. Accelerating and set adjusted versions are acceptable. Concrete setting time and mixture workability shall be evaluated.

2.2.6.4 High Range Water Reducer (HRWR)

ASTM C494/C494M, Type F and ASTM C1017/C1017M.

2.2.6.5 Retarding

ASTM C494/C494M, Type B, D, or G.

2.2.6.6 Water Reducing

ASTM C494/C494M, Type A, E, or F.

2.2.7 Reinforcement

2.2.7.1 Reinforcing Bars

ACI 301 unless otherwise specified and shall meet the design strength and ductility requirements. Deformed reinforcing bars meeting the requirements of ASTM A706/A706M, Grade 60 prefabricated and then coated in accordance with ASTM A767/A767M, Class 1 galvanized after fabrication.

2.2.7.2 Wire

ASTM A1064/A1064M, galvanized in accordance with ASTM A641/A641M, Class C.

2.2.7.3 Welded Wire Reinforcement

ASTM A1064/A1064M, galvanized in accordance with ASTM A641/A641M, Class C.

2.2.7.4 Supports for Concrete Reinforcement

Include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcement bars and wire in place.

Ensure legs of supports in contact with formwork for sections that will be exposed to weather are hot-dip galvanized after fabrication, plastic coated, or corrosion-resistant steel bar supports.

2.2.8 Prestressing Strands

Use seven-wire low-relaxation strand conforming to ASTM A416/A416M, Grade 270. Use prestressing steel free of grease, oil, wax, paint, soil, dirt, and loose rust. Do not use prestressing strands or wire having kinks, bends, or other defects.

2.2.9 Metal Accessories

Provide ASTM A123/A123M or ASTM A153/A153M galvanized.

2.2.9.1 Inserts

ASTM A47/A47M, Grade 32510, or ASTM A27/A27M Grade 60-30. Submit product data.

2.2.9.2 Structural Steel

- a. Wide Flanges/WT Shapes: ASTM A992/A992M or ASTM A572/A572M, Grade 50
- b. Channels: ASTM A992/A992M or ASTM A572/A572M, Grade 50.

c. Shapes, Plates and Bars: ASTM A572/A572M, Grade 50.

d. Angles: ASTM A36/A36M

2.2.9.3 Bolts

ASTM A307; ASTM F3125/F3125M, Grade A325, Type 1, as required.

2.2.9.4 Nuts

ASTM A563, Grade as required to match bolt type.

2.2.9.5 Washers

ASTM F844 washers for ASTM A307 bolts, and ASTM F436 washers for ASTM F3125/F3125M bolts.

2.2.9.6 Headed Studs

ASTM A108, Grades 1010 through 1020 and AWS D1.1/D1.1M, Chapter 7.

2.2.10 Bearing Pads

Submit product data for all bearing pads being used.

2.2.10.1 Elastomeric

AASHTO M 251, for plain neoprene bearings.

2.2.10.2 Random-Oriented, Fiber-Reinforced Elastomeric Pads

Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer according to ASTM D2240. Capable of supporting a compressive stress of 3000 psi with no cracking, splitting or delaminating in the internal portion of the pad.

2.2.10.3 Cotton-Duck-Fabric-Reinforced Elastomeric Pads

Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A durometer according to ASTM D2240. Conforming to Division II, Section 18.10.2 of AASHTO LRFD CONS Bridge Design Specifications or Military Specification MIL-C-882.

2.2.10.4 High-Density Plastic

Multimonomer, nonleaching, plastic strip capable of supporting loads with no visible overall expansion.

2.3 PRODUCTION QUALITY CONTROL PROCEDURES

PCI MNL-116 unless specified otherwise.

Where structural precast concrete is manufactured in a plant with an established quality control program as attested to by a current certification in the PCI "Certification Program for Quality Control" or the QA/QC procedure established under the ISO 9001 certification program, perform product quality control in accordance with PCI MNL-116 or ISO 9001, respectively. Where structural precast concrete is manufactured by

specialists or in plants not currently enrolled in the PCI "Certification Program for Quality Control," or the QA/QC procedure established under the ISO 9001 certification program, set-up a product quality control system in accordance with PCI MNL-116 or ISO 9001, respectively, and perform concrete and aggregate quality control testing using an independent commercial testing laboratory approved by the Contracting Officer.

2.3.1 Forms

Brace forms to prevent deformation. Forms must produce a smooth, dense surface. Use forms and form-facing materials that are nonreactive with concrete such as wood, metal, plastic, or other approved materials. Conform to the shapes, lines, and dimensions indicated and are within the limits of the specified fabrication tolerances. Chamfer exposed edges of columns and beams 3/4 inch, unless otherwise indicated. Provide threaded or snap-off type form ties.

2.3.2 Tolerances

Fabricate structural precast concrete members of shapes, lines and dimensions indicated, so each finished member complies with PCI MNL-135 product tolerances as well as position tolerances for cast-in items.

2.3.3 Reinforcement Placement

ACI 318 and PCI MNL-116 for placement and splicing. Place and secure steel bars, welded-wire reinforcement, and other reinforcement by means of metal bar supports and spacers. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between precast prestressed and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections.

2.3.4 Inserts

When the ends of the prestressed member will be exposed, recess the prestressing stands using inserts. After detensioning, remove inserts and fill the recess with nonshrink grout.

2.3.5 Built-In Anchorage Devices

Position, anchor, and locate anchorage devices where they do not affect the position of the main reinforcement or placing concrete. Bearing plates; set level, aligned properly, and anchored in the exact location indicated.

2.3.6 Lifting Devices

Provide lifting devices designed for 100-percent impact, and of materials sufficiently ductile to ensure visible deformation before fracture.

2.3.7 Blockouts

Provide blockouts as indicated.

2.3.8 Identification Markings

Clearly mark each structural section in a permanent manner to indicate its location and orientation in the building and the pickup points.

Ensure each structural section has the date of casting plainly indented in the unexposed face of the concrete.

2.3.9 Concrete

2.3.9.1 Concrete Mixing

ASTM C94/C94M. Mixing operations must produce batch-to-batch uniformity of strength, consistency, and appearance.

2.3.9.2 Concrete Placing

PCI MNL-116.

2.3.9.3 Concrete Curing

PCI MNL-116, except as modified herein..

- a. Precast units must be cured by one of the methods of curing described or by a method approved in writing.
- b. Units must be cured until 6-inch concrete test cylinders poured during the manufacturing cured in the same environment have attained the full minimum compressive strength indicated on the Contract Drawings.
- c. Initial curing in the casting bed must begin as soon after finishing as possible and continue until the required strength for handling is attained. After removal of the precast units from the casting bed to nearby storage, curing shall continue for a minimum period of seven (7) days or longer until the concrete has attained a minimum compressive strength of 5,000 psi as confirmed by cylinder compression tests.
- d. Moist Curing
 - (1) If units are to be moist cured, they must be covered with two (2) layers of wet burlap or curing mats after the finishing operations are completed. The mats shall be kept wet by a system of perforated pipes, mechanical sprinklers, porous hose, or other Contracting Officer approved methods for the entire curing period. Before and during placing of the curing mats the concrete must be kept moist by a fine fog spray of water commencing after finishing operations have ceased.
 - (2) Water for curing must be clean fresh water conforming to the requirements for mixing water.
- e. Steam Curing
 - (1) Immediately after each unit has been cast and finished, it must be placed in a curing chamber, curing box, or under a tight enclosure which will protect the units from wind drafts. Such chambers and enclosures must be sized to allow full circulation of steam around exposed surfaces of the precast unit.
 - (2) Instrumentation: Install exterior recording thermometers and interior temperature probes with enclosures and power source along with wiring. Each precast unit shall be instrumented with either

one exterior thermometer or one interior probe. Exterior thermometers and interior probes shall be installed in an alternating sequence. Parallel casting beds shall have the instrumentation placed in a staggered and alternating pattern along the unit. The thermometer and the probe shall be installed close to the middle of the unit, not closer than 5 feet and not farther than 10 feet from the orifice where the steam is introduced. The exterior thermometer shall be located at the side where the steam is introduced. The interior probe shall be located more than 8-inches and less than 10-inches from the surface of concrete. Do not commence concrete placement until temperature recording devices have been checked to the satisfaction of the Contracting Officer. A uniform curing temperature shall be maintained throughout the entire length of the units. Submit prints of the automatic readout daily.

(3) Commencing not earlier than three (3) hours and not later than five (5) hours after completion of concrete placement, the precast units shall be subjected to the continuous action of steam. Care shall be exercised to see that heat is introduced gradually to avoid thermal shock to the concrete. During the heating, the temperature rise shall not exceed 40 degrees F per hour. The interior temperature of the units shall be held at a target maximum temperature of 150 degrees F.

(4) Cooling shall follow the steaming cycle. Care shall be exercised to protect the precast units from rapid drops in temperature, mechanical injury and other conditions likely to cause damage or loss of strength. During the cooling, the temperature drop shall not exceed 20 degrees F per hour until a temperature of 20 degrees F above ambient air temperature is reached. The cool down procedures shall be as follows:

(a) Steam shall be turned off following the steam cycle.

(b) The sides of the tarps shall be folded to the top of the form

(c) The tarps shall be completely removed, the top doors will be opened.

(5) After steam curing, moist curing shall be applied until a total steam and moist curing time of seven days is achieved.

2.3.10 Prestressing

PCI MNL-116. Do not transfer prestressing forces during detensioning until the concrete has reached a minimum compressive strength of 3500 psi , unless a higher strength is required by the Contractor furnished design.

2.3.11 Surface Finish

Repairs located in a bearing area must be approved by the Contracting Officer prior to repairs. Defects must be repaired or rejected as specified in paragraph ACCEPTANCE/REJECTION OF DEFECTS.

2.3.11.1 Unformed Surfaces

Provide a steel troweled finish for unformed, exposed surfaces of precast units unless otherwise noted..

Provide a transverse raked finish with an amplitude not less than 1/4 inch on top of prestressed units that are to receive a topping.

2.3.11.2 Formed Surfaces

PCI MNL-116, Appendix C, for grades of surface finishes.

- a. Unexposed Surfaces: Provide a standard grade surface finish.
- b. Exposed Surfaces: Provide a finish Grade B surface finish. The combined area of acceptable defective areas must not exceed 0.2 percent of the exposed to view surface area, and the patches must be indistinguishable from the surrounding surfaces when dry.

2.3.12 Acceptance/Rejection of Defects

2.3.12.1 Minor Defects

All honeycombed areas, chipped corners, air pockets over 1/4 inch in diameter, and other minor defects involve less than 36 square inches of concrete must be repaired. Form offsets of fins over 1/8 inch must be ground smooth. All unsound concrete must be removed from defective areas prior to repairing. All surfaces permanently exposed to view must be repaired by a blend of portland cement and white cement properly proportioned so that the final color when cured will be the same as adjacent concrete. Precast prestressed members containing hairline cracks which are visible and are less than 0.01 inches in width, may be accepted, except that cracks larger than 0.005 inches in width for surfaces exposed to the weather must be repaired.

2.3.12.2 Major Defects

Major defects are those which involve more than 36 square inches of concrete or expose stressing tendons or reinforcing steel. If one or more major defects appear in a member, it will be rejected. Cracks of a width of more than 0.01 inch will be cause for rejection of the member.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

2.4.1 Chloride Ion Concentration Test

Sampling and determination of water soluble chloride ion content in accordance with ASTM C1218/C1218M. Maximum water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days contributed from the ingredients including water, aggregates, cementitious materials, and admixtures must not exceed 0.06 percent by weight of cement.

2.4.2 Chloride Ion Penetration Test

To ensure the durability of concrete in marine environment, concrete must be proportioned to have the chloride ion penetration test in accordance with ASTM C1202, and be below 1500 coulombs for concrete specimens tested at 28 days.

2.4.3 Factory Inspection

At the option of the Contracting Officer, precast prestressed units may be inspected by the Contracting Officer prior to being transported to the job

site. The Contractor must give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to erection, and again after installation, precast prestressed members must be checked for damage, such as cracking, spalling, and honeycombing. As directed by the Contracting Officer, precast prestressed members that do not meet the surface finish requirements specified in paragraph SURFACE FINISH must be repaired, or removed and replaced with new precast prestressed members.

3.2 ERECTION

Precast prestressed members must be erected after the concrete has attained the specified compressive strength. Erect in accordance with the approved shop drawings. PCI MNL-135 for tolerances. Provide a 1:500 tolerance, if no tolerance is specified. Follow the manufacturer's recommendations for maximum construction loads. Place precast prestressed members level, plumb, square, and true within tolerances. Align member ends.

3.3 BEARING SURFACES

Must be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the precast prestressed member and adjacent precast prestressed members or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Do not use hardboard bearing pads in exterior locations. Place precast prestressed members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

3.4 ANCHORAGE

Provide exposed strand anchorage for fastening work in place. Make threaded connections up tight and nick threads to prevent loosening.

3.5 WELDING

AWS D1.1/D1.1M, AWS D1.4/D1.4M for welding connections and reinforcing splices. Protect the concrete and other reinforcing from heat during welding. Weld continuously along the entire area of contact. Welding of galvanized reinforcing is not allowed.

3.6 OPENINGS

Holes or cuts requiring prestressing steel to be cut, which are not indicated on the approved shop drawing, must only be made with the approval of the Contracting Officer and the precast manufacturer. Drill holes less than 12 inches in diameter with a diamond tipped core drill. Ensure cuts are straight and at 90 degrees to the surfaces without breaking or spalling the edges.

3.7 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanized surfaces damaged by handling, transporting, cutting, welding, bolting, or acid washing. Do not heat surfaces to which repair paint has been applied.

3.8 GROUTING

Clean and fill keyways between precast prestressed members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

3.9 SEALANTS

Provide as indicated and as specified in Section 07 92 00 JOINT SEALANTS.

3.10 PROTECTION AND CLEANING

Protect exposed-to-view surfaces against staining and other damage until completion of the work.

Upon completion of installation, swept clean and leave ready slab surfaces to receive concrete floor topping, roofing, or other covering.

3.11 CONCRETE TOPPING

Provide as indicated and as specified in Section 03 31 30 MARINE CONCRETE.

3.12 CONSTRUCTION RECORDS

Complete construction records must be kept of the manufacturing, handling, and erection of the precast-prestressed concrete members and submitted. Records must be kept for, but not limited to, the following items:

- a. Specifications of material used in the manufacture of the members.
- b. Time-temperature history of the concrete members from casting to the transfer of the prestress force.
- c. Records of the tendon stressing operation including initial prestress force, measured elongation, how it was measured, and how the tendons were stressed and destressed.
- d. Records of inspection of the members before and after the prestress force is transferred to the members.
- e. Records of the inspection of the members each time they are moved.
- f. Records of any defects in the member and any corrective measures taken.

-- End of Section --

SECTION 04 20 00

UNIT MASONRY

11/15, CHG 2: 05/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI SP-66 (2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M (2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A185/A185M (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

ASTM A615/A615M (2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A641/A641M (2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

ASTM A653/A653M (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A951/A951M (2011) Standard Specification for Steel Wire for Masonry Joint Reinforcement

ASTM A996/A996M (2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

ASTM A1008/A1008M (2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

ASTM A1064/A1064M (2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

ASTM C90	(2016) Standard Specification for Loadbearing Concrete Masonry Units
ASTM C129	(2017) Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C207	(2018) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C270	(2019) Standard Specification for Mortar for Unit Masonry
ASTM C476	(2020) Standard Specification for Grout for Masonry
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C641	(2017) Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates
ASTM C780	(2020) Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C1019	(2019) Standard Test Method for Sampling and Testing Grout
ASTM C1314	(2014) Standard Test Method for Compressive Strength of Masonry Prisms
ASTM C1384	(2012a) Standard Specification for Admixtures for Masonry Mortars
ASTM C1611/C1611M	(2021) Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM D2000	(2018) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2287	(2019) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E514/E514M	(2014a) Standard Test Method for Water Penetration and Leakage Through Masonry

THE MASONRY SOCIETY (TMS)

TMS MSJC	(2016) Masonry Standard Joint Committee's (MSJC) Book - Building Code Requirements and Specification for Masonry Structures, Containing TMS 402/ACI 530/ASCE 5, TMS 602/ACI 530.1/ASCE 6, and Companion Commentaries
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Cut CMU Drawings; G

Reinforcement Detail Drawings; G

SD-03 Product Data

Hot Weather Procedures; G

Cold Weather Procedures; G

Cement; G

Cementitious Materials; G

Precast Splashblock; G

SD-04 Samples

Concrete Masonry Units (CMU); G

SD-05 Design Data

Masonry Compressive Strength; G

SD-06 Test Reports

Field Testing of Mortar

Field Testing of Grout

Prism Tests

Single-Wythe Masonry Wall Water Penetration Test

SD-07 Certificates

Special Masonry Inspector Qualifications

VOC Emissions; S

Recycled Content; S

Regional Material; S

Concrete Masonry Units (CMU)

Precast Concrete Units

Cementitious Materials

Admixtures for Masonry Mortar

Admixtures for Grout

Anchors, Ties, and Bar Positioners

Joint Reinforcement

SD-08 Manufacturer's Instructions

Admixtures for Masonry Mortar

Admixtures for Grout

SD-10 Operation and Maintenance Data

Take-Back Program; S

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 IEQ Low-Emitting Materials

For mortar and grout applied inside the weatherproofing system - submit VOC statement indicating compliance with the:

a. VOC Emissions

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of cementitious materials.

Provide Extended Producer Responsibility (EPR/Product Take-Back Programs) data.

Provide regional material certifications for all materials that apply.

1.3 QUALITY ASSURANCE

1.3.1 Special Masonry Inspector Qualifications

Refer to Section 01 45 35 SPECIAL INSPECTIONS for qualifications and responsibilities of the masonry special inspector.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store, handle, and protect material to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.4.1 Masonry Units

Cover and protect masonry units from precipitation. Conform to handling and storage requirements of TMS MSJC.

a. Pack glazed brick, glazed structural clay tile, and prefaced concrete

masonry units in the manufacturer's standard paper cartons, trays, or shrink wrapped pallets with a divider between each unit. Do not stack pallets. Do not remove units from cartons until cartons are placed on scaffolds or in the location where units are to be laid.

- b. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Store steel reinforcing bars, coated anchors, ties, and joint reinforcement above the ground. Maintain steel reinforcing bars and uncoated ties free of loose mill scale and loose rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious material in dry, weathertight enclosures or completely cover. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination and segregation.

1.5 PROJECT/SITE CONDITIONS

Conform to TMS MSJC for hot and cold weather masonry erection.

1.5.1 Hot Weather Procedures

When ambient air temperature exceeds 100 degrees F, or exceeds 90 degrees F and the wind velocity is greater than 8 mph, comply with TMS MSJC Article 1.8 D for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

1.5.2 Cold Weather Procedures

When ambient temperature is below 40 degrees F, comply with TMS MSJC Article 1.8 C for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design - Specified Compressive Strength of Masonry

The specified compressive strength of masonry, f'_m , is 2000 psi, unless otherwise noted.

2.1.2 Performance - Verify Masonry Compressive Strength

Verify specified compressive strength of masonry using the "Unit Strength Method" of TMS MSJC. Submit calculations and certifications of unit and mortar strength.

Verify specified compressive strength of masonry using the "Prism Test Method" of TMS MSJC when the "Unit Strength Method" cannot be used.

Submit test results.

2.2 MANUFACTURED UNITS

2.2.1 General Requirements

Do not change the source of materials, which will affect the appearance of the finished work, after the work has started except with Contracting Officer's approval. Submit test reports from an approved independent laboratory. Certify test reports on a previously tested material as the same materials as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

2.2.2 Concrete Units

2.2.2.1 Aggregates

Test lightweight aggregates, and blends of lightweight and heavier aggregates in proportions used in producing the units, for stain-producing iron compounds in accordance with ASTM C641, visual classification method. Do not incorporate aggregates for which the iron stain deposited on the filter paper exceeds the "light stain" classification.

Use industrial waste by-products (air-cooled slag, cinders, or bottom ash), ground waste glass and concrete, granulated slag, and expanded slag in aggregates.

2.2.2.2 Concrete Masonry Units (CMU)

2.2.2.2.1 Cement

Use only cement that has a low alkali content and is of one brand.

2.2.2.2.2 Recycled Content

Provide units with a minimum of 10 percent post-consumer recycled content, or a minimum of 40 percent post-industrial recycled content, based on mass, cost, or volume.

2.2.2.2.3 Size

Provide units with specified dimension of 7-5/8 inches wide, 7-5/8 inches high, and 15-5/8 inches long, unless noted otherwise.

2.2.2.2.4 Weather Exposure

Provide concrete masonry units with water-repellant admixture added during manufacture where units will be exposed to weather.

2.2.2.2.5 Unit Types

- a. Hollow Load-Bearing Units: ASTM C90, lightweight. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.
- b. Hollow Non-Load-Bearing Units: ASTM C129, lightweight. Load-bearing units may be provided in lieu of non-load-bearing units.

2.2.2.2.6 Jamb Units

Provide jamb units of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved.

Provide sash jamb units with a 3/4 by 3/4 inch groove near the center at end of each unit.

2.2.3 Precast Concrete Units

2.2.3.1 General

- a. Provide precast concrete trim, lintels, copings, splashblocks and sills that are factory-made units in a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, provide precast concrete with minimum 3000 psi compressive strength, conforming to Section 03 30 00 CAST-IN-PLACE CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and with reinforcement required for handling of the units. Maintain minimum clearance of 3/4 inch between reinforcement and faces of units.
- b. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 psi for at least 5 hours, either damp-cure for 24 hours or steam-cure and then age under cover for 28 days or longer. In precast concrete members weighing over 80 pounds provide built-in loops of galvanized wire or other approved provisions for lifting and anchoring.
- c. Fabricate units with beds and joints at right angles to the face, with sharp true arises and with drip grooves on the underside where units overhang walls. Form exposed-to-view surfaces free of surface voids, spalls, cracks, and chipped or broken edges and with uniform appearance and color. Unless otherwise specified, provide units with a smooth dense finish.
- d. Prior to installation, wet and inspect each unit for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.
- e. Submit specified factory certificates.

2.2.3.2 Precast Splashblocks

Splashblocks to be provided at each downspout or condensate line that drains above grade. Splashblocks to be precast, color standard gray. Size to be as shown on drawings with lip around three sides. Center portion to slope away from building at 1/4 inch per foot.

2.3 EQUIPMENT

2.3.1 Vibrators

Maintain at least one spare vibrator on site at all times.

2.3.2 Grout Pumps

Pumping through aluminum tubes is not permitted.

2.4 MATERIALS

2.4.1 Mortar Materials

2.4.1.1 Cementitious Materials

Provide cementitious materials that conform to those permitted by ASTM C270.

2.4.1.2 Hydrated Lime and Alternates

Provide lime that conforms to one of the materials permitted by ASTM C207 for use in combination with portland cement, hydraulic cement, and blended hydraulic cement. Do not use lime in combination with masonry cement or mortar cement.

2.4.1.3 Admixtures for Masonry Mortar

In cold weather, use a non-chloride based accelerating admixture that conforms to ASTM C1384, unless Type III portland cement is used in the mortar.

In showers and kitchens, use mortar that contains a water-repellent admixture that conforms to ASTM C1384. Provide a water-repellent admixture, conforming to ASTM C1384 and of the same brand and manufacturer as the block's integral water-repellent, in the mortar used to place concrete masonry units that have an integral water-repellent admixture.

2.4.1.4 Aggregate and Water

Provide aggregate (sand) and water that conform to materials permitted by ASTM C270.

2.4.2 Grout and Ready-Mix Grout Materials

2.4.2.1 Cementitious Materials for Grout

Provide cementitious materials that conform to those permitted by ASTM C476.

2.4.2.2 Admixtures for Grout

Water-reducing admixtures that conform to ASTM C494/C494M Type F or G and viscosity-modifying admixtures that conform to ASTM C494/C494M Type S are permitted for use in grout. Other admixtures require approval by the Contracting Officer.

In cold weather, a non-chloride based accelerating admixture may be used subject to approval by the Contracting Officer; use accelerating admixture that is non-corrosive and conforms to ASTM C494/C494M, Type C.

2.4.2.3 Aggregate and Water

Provide fine and coarse aggregates and water that conform to materials permitted by ASTM C476.

2.5 MORTAR AND GROUT MIXES

Submit manufacturer's product data, indicating VOC emissions.

2.5.1 Mortar Mix

- a. Provide mortar Type M or S unless specified otherwise herein.
- b. Use ASTM C270 Type M or S cement-lime mortar or mortar cement mortar for seismic-force-resisting elements indicated.
- c. For field-batched mortar, measure component materials by volume. Use measuring boxes for materials that do not come in packages, such as sand, for consistent batching. Mix cementitious materials and aggregates between 3 and 5 minutes in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Do not hand mix mortar unless approved by the Contracting Officer. Maintain workability of mortar by remixing or retempering. Discard mortar that has begun to stiffen or is not used within 2-1/2 hours after initial mixing.
- d. For preblended mortar, follow manufacturer's mixing instructions.

2.5.2 Grout and Ready Mix Grout Mix

Use grout that conforms to ASTM C476. Use conventional grout with a slump between 8 and 11 inches. Use self-consolidating grout with slump flow of 24 to 30 inches and a visual stability index (VSI) not greater than 1. Provide minimum grout strength of 2000 psi in 28 days, as tested in accordance with ASTM C1019. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that grout meets the specified requirements. Use ready-mixed grout that conforms to ASTM C476.

2.6 ACCESSORIES

2.6.1 Grout Barriers

Grout barriers for vertical cores that consist of fine mesh wire, fiberglass, or expanded metal.

2.6.2 Anchors, Ties, and Bar Positioners

2.6.2.1 General

- a. Fabricate anchors and ties without drips or crimps. Size anchors and ties to provide a minimum of 5/8 inch mortar cover from each face of masonry.
- b. Fabricate steel wire anchors and ties shall from wire conforming to ASTM A1064/A1064M and hot-dip galvanize in accordance with ASTM A153/A153M.
- c. Fabricate joint reinforcement in conformance with ASTM A951/A951M. Hot dip galvanize joint reinforcement in exterior walls and in interior walls exposed to moist environment in conformance with ASTM A153/A153M. Galvanize joint reinforcement in other interior walls in conformance with ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below.
- d. Fabricate sheet metal anchors and ties in conformance with ASTM A1008/A1008M. Hot dip galvanize sheet metal anchors and ties in exterior walls and in interior walls exposed to moist environment in

compliance with ASTM A153/A153M Class B. Galvanize sheet metal anchors and ties in other interior walls in compliance with ASTM A653/A653M, Coating Designation G60.

- e. Submit two anchors, ties and bar positioners of each type used, as samples.

2.6.2.2 Wire Mesh Anchors

Provide wire mesh anchors of 1/4 inch mesh galvanized hardware cloth, conforming to ASTM A185/A185M, with length not less than 12 inches, at intersections of interior non-bearing masonry walls.

2.6.2.3 Adjustable Anchors

2.6.2.3.1 Anchorage to Structural Steel

Provide hot-dip galvanized adjustable anchors for connecting masonry walls to the structural steel frame as detailed on the drawings. Provide zinc-rich paint for touching up paint after welding galvanized anchors to structural steel.

2.6.2.4 Bar Positioners

Factory-fabricate bar positioners, used to prevent displacement of reinforcing bars during the course of construction, from 9 gauge steel wire or equivalent, and hot-dip galvanized. Bar positioners must be suitable for intended use and be corrosion resistant steel. Bar positioners not fully contained within the wythe must be hot-dip galvanized.

2.6.3 Joint Reinforcement

Factory fabricate joint reinforcement in conformance with ASTM A951/A951M, welded construction. Provide ladder type joint reinforcement, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units and with all wires a minimum of 9 gauge. Size joint reinforcement to provide a minimum of 5/8 inch cover from each face. Space crosswires not more than 16 inches. Provide joint reinforcement for straight runs in flat sections not less than 10 feet long. Provide joint reinforcement with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.6.4 Reinforcing Steel Bars

Reinforcing steel bars and rods shall conform to ASTM A615/A615M or ASTM A996/A996M, Grade 60.

2.6.5 Concrete Masonry Control Joint Keys

Provide control joint keys of a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D2000 M2AA-805 with a minimum durometer hardness of 80 or polyvinyl chloride conforming to ASTM D2287 Type PVC 654-4 with a minimum durometer hardness of 85. Form the control joint key with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of

plus or minus 1/16 inch, to fit neatly, but without forcing, in masonry unit jamb sash grooves.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to start of work, verify the applicable conditions as set forth in TMS MSJC, inspection.

3.2 PREPARATION

3.2.1 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.2.2 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.2.3 Concrete Surfaces

Where masonry is to be placed, clean concrete of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.4 Shelf Angles

Adjust shelf angles as required to keep the masonry level and at the proper elevation.

3.2.5 Bracing

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by OSHA and local codes and provide bracing calculations, sealed by a registered professional engineer. Do not remove bracing in less than 10 days.

3.3 ERECTION

3.3.1 General

- a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Lay masonry units in running bond pattern. Lay facing courses level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances is plus or minus 1/2 inch. Adjust each unit to its final position while mortar is still soft and has plastic consistency.
- b. Remove and clean units that have been disturbed after the mortar has stiffened, and relay with fresh mortar. Keep air spaces, cavities, chases, expansion joints, and spaces to be grouted free from mortar

and other debris. Select units to be used in exposed masonry surfaces from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work.

- c. When necessary to temporarily discontinue the work, step (rack) back the masonry for joining when work resumes. Toothing may be used only when specifically approved by the Contracting Officer. Before resuming work, remove loose mortar and thoroughly clean the exposed joint. Cover the top of walls subjected to rain or snow with nonstaining waterproof covering or membrane when work is not in process. Extend the covering a minimum of 610 mm 2 feet down on each side of the wall and hold securely in place.
- d. Ensure that units being laid and surfaces to receive units are free of water film and frost. Lay solid units in a nonfurrowed full bed of mortar. Bevel mortar for veneer wythes and slope down toward the cavity side. Shove units into place so that the vertical joints are tight. Completely fill vertical joints between solid units with mortar, except where indicated at control, expansion, and isolation joints. Place hollow units so that mortar extends to the depth of the face shell at heads and beds, unless otherwise indicated. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Provide means to prevent mortar from dropping into the space below or clean grout spaces prior to grouting.

3.3.1.1 Jointing

Tool mortar joints when the mortar is thumbprint hard. Tool horizontal joints after tooling vertical joints. Brush mortar joints to remove loose and excess mortar.

3.3.1.1.1 Tooled Joints

Tool mortar joints in exposed exterior and interior masonry surfaces concave, using a jointer that is slightly larger than the joint width so that complete contact is made along the edges of the unit. Perform tooling so that the mortar is compressed and the joint surface is sealed. Use a jointer of sufficient length to obtain a straight and true mortar joint. No exterior joints are to be left un-tooled.

3.3.1.1.2 Flush Joints

Flush cut mortar joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas. Finish flush cut joints by cutting off the mortar flush with the face of the wall. Point joints in unparged masonry walls below grade tight. For architectural units, such as fluted units, completely fill both the head and bed joints and flush cut.

3.3.1.1.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.3.1.1.4 Joint Widths

- a. Construct brick masonry with mortar joint widths equal to the difference between the specified and nominal dimensions of the unit,

within tolerances permitted by TMS MSJC.

- b. Provide 3/8 inch wide mortar joints in concrete masonry, except for prefaced concrete masonry units.
- c. Provide 3/8 inch wide mortar joints on unfaced side of prefaced concrete masonry units and not less than 3/16 inch nor more than 1/4 inch wide on prefaced side.
- d. Maintain mortar joint widths within tolerances permitted by TMS MSJC.

3.3.1.2 Cutting and Fitting

Use full units of the proper size wherever possible, in lieu of cut units. Locate cut units where they would have the least impact on the architectural aesthetic goals of the facility. Perform cutting and fitting, including that required to accommodate the work of others, by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Before being placed in the work, dry wet-cut units to the same surface-dry appearance as uncut units being laid in the wall. Provide cut edges that are clean, true and sharp.

- a. Carefully make openings in the masonry so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Provide reinforced masonry lintels above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.
- b. Do not reduce masonry units in size by more than one-third in height and one-half in length. Do not locate cut products at ends of walls, corners, and other openings.

3.3.1.3 Unfinished Work

Rack back unfinished work for joining with new work. Tothing may be resorted to only when specifically approved by the Contracting Officer. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

3.3.1.4 Control Joints

Provide control joints in concrete masonry as indicated. Construct by using special control-joint units in accordance with the details shown on the Drawings. Form a continuous vertical joint at control joint locations, including through bond beams, by utilizing half blocks in alternating courses on each side of the joint. Interrupt the control joint key in courses containing continuous bond beam reinforcement. Do not interrupt the horizontal reinforcement and grout at the control joint.

Where mortar was placed in the joint, rake both faces of the control joints to a depth of 3/4 inch. Install backer rod and sealant on both faces in accordance with Section 07 92 00 JOINT SEALANTS.

3.3.2 Reinforced, Single Wythe Concrete Masonry Units Walls

3.3.2.1 Concrete Masonry Unit Placement

- a. Fully bed units used to form piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout in mortar under both face shells and webs. Provide mortar beds under both face shells for other units. Mortar head joints for a distance in from the face of the unit not less than the thickness of the face shell.
- b. Solidly grout foundation walls below grade.
- c. Stiffen double walls at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of each wall within the double wall. Adequately reinforce walls and partitions for support of wall-hung plumbing fixtures when chair carriers are not specified.
- d. Submit drawings showing elevations of walls exposed to view and indicating the location of all cut CMU products.

3.3.2.2 Preparation for Reinforcement

Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be grouted. Remove mortar protrusions extending 1/2 inch or more into cells before placing grout. Position reinforcing bars accurately as indicated before placing grout. Where vertical reinforcement occurs, fill cores solid with grout in accordance with paragraph PLACING GROUT in this Section.

3.3.3 ANCHORAGE

3.3.3.1 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 24 inches on centers horizontally.

3.3.3.2 Anchorage at Intersecting Walls

Provide wire mesh anchors at maximum 16 inches spacing at intersections of interior non-bearing masonry walls.

Anchor structural masonry walls with reinforced bond beams spaced no more than 4 feet on center, unless the drawings indicate a movement joint at the intersection.

3.3.4 Lintels

3.3.4.1 Masonry Lintels

Construct masonry lintels with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated. Extend lintel reinforcement beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Support reinforcing bars in place prior to grouting and locate 1/2 inch above the bottom inside surface of the lintel unit.

3.3.4.2 Precast Concrete and Steel Lintels

Provide precast concrete and steel lintels as shown on the Drawings. Set lintels in a full bed of mortar with faces plumb and true. Provide steel and precast lintels with a minimum bearing length of 8 inches unless otherwise indicated. In partially grouted masonry, provide fully grouted units under the full lintel bearing length, unless otherwise indicated.

3.4 INSTALLATION

3.4.1 Bar Reinforcement Installation

3.4.1.1 Preparation

Submit detail drawings showing bar splice locations. Identify bent bars on a bending diagram and reference and locate such bars on the drawings. Show wall dimensions, bar clearances, and wall openings. Utilize bending details that conform to the requirements of ACI SP-66. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, resubmit the approved shop drawings with the additional openings shown along with the proposed changes. Clearly highlight location of these additional openings. Provide wall elevation drawings with minimum scale of 1/4 inch per foot. Submit drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings.

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, and other coatings that might destroy or reduce its bond prior to placing grout. Do not use bars with kinks or bends not shown on the approved shop drawings. Place reinforcement prior to grouting. Unless otherwise indicated, extend vertical wall reinforcement to within 2 inches of tops of walls.

3.4.1.2 Positioning Bars

- a. Accurately place vertical bars within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Provide minimum clearance between parallel bars of 1/2 inch between the bars and masonry units for coarse grout and a minimum clearance of 1/4 inch between the bars and masonry units for fine grout. Provide minimum clearance between parallel bars of 1 inch or one diameter of the reinforcement, whichever is greater. Vertical reinforcement may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement or by other means to prevent displacement beyond permitted tolerances. As masonry work progresses, secure vertical reinforcement to prevent displacement beyond allowable tolerances.
- b. Wire column and pilaster lateral ties in position around the vertical reinforcing bars. Place lateral ties in contact with the vertical reinforcement and do not place in horizontal mortar bed joints.
- c. Position horizontal reinforcing bars as indicated. Stagger splices in adjacent horizontal bars, unless otherwise indicated.

- d. Form splices by lapping bars as indicated. Do not cut, bend or eliminate reinforcing bars. Foundation dowel bars may be field-bent when permitted by TMS MSJC.

3.4.1.3 Splices of Bar Reinforcement

Lap splice reinforcing bars as indicated. When used, provide welded or mechanical connections that develop at least 125 percent of the specified yield strength of the reinforcement.

3.4.2 Placing Grout

3.4.2.1 General

Fill cells containing reinforcing bars with grout. Solidly grout hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces. Solidly grout cells under lintel bearings on each side of openings for full height of openings. Solidly grout walls below grade, lintels, and bond beams. Units other than open end units may require grouting each course to preclude voids in the units.

Discard site-mixed grout that is not placed within 1-1/2 hours after water is first added to the batch or when the specified slump is not met without adding water after initial mixing. Discard ready-mixed grout that does not meet the specified slump without adding water other than water that was added at the time of initial discharge. Allow sufficient time between grout lifts to preclude displacement or cracking of face shells of masonry units. Provide a grout shear key between lifts when grouting is delayed and the lower lift loses plasticity. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, tear down the wall and rebuild.

3.4.2.2 Vertical Grout Barriers for Multi-Wythe Composite Walls

In multi-wythe composite walls, provide grout barriers in the collar joint not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.4.2.3 Horizontal Grout Barriers

Embed horizontal grout barriers in mortar below cells of hollow units receiving grout.

3.4.2.4 Grout Holes and Cleanouts

3.4.2.4.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 16 inches on centers where grouting of hollow unit masonry is indicated. Form such openings not less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.4.2.4.2 Cleanouts for Hollow Unit Masonry Construction

For hollow masonry units, provide cleanout holes at the bottom of every grout pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet 4 inches. Where all cells are to be grouted, construct cleanout courses using bond beam units in an inverted position to permit cleaning of all cells. Provide cleanout holes at a maximum spacing of 32 inches where all cells are to be filled with grout.

Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Provide cleanouts not less than 3 by 3 inch by cutting openings in one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Do not cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.5 Grout Placement

A grout pour is the total height of masonry to be grouted prior to erection of additional masonry. A grout lift is an increment of grout placement within a grout pour. A grout pour is filled by one or more lifts of grout.

- a. Lay masonry to the top of a pour permitted by TMS MSJC Table 7, based on the size of the grout space and the type of grout. Prior to grouting, remove masonry protrusions that extend 1/2 inch or more into cells or spaces to be grouted. Provide grout holes and cleanouts in accordance with paragraph GROUT HOLES AND CLEANOUTS above when the grout pour height exceeds 5 feet 4 inches. Hold reinforcement, bolts, and embedded connections rigidly in position before grouting is started. Do not prewet concrete masonry units.
- b. Place grout using a hand bucket, concrete hopper, or grout pump to fill the grout space without segregation of aggregate. Operate grout pumps to produce a continuous stream of grout without air pockets, segregation, or contamination.
- c. If the masonry has cured at least 4 hours, grout slump is maintained between 10 to 11 inches, and no intermediate reinforced bond beams are placed between the top and bottom of the pour height, place conventional grout in lifts not exceeding 12 feet 8 inches. For the same curing and slump conditions but with intermediate bond beams, limit conventional grout lift to the bottom of the lowest bond beam that is more than 5 feet 4 inches above the bottom of the lift, but do not exceed 12 feet 8 inches. If masonry has not cured at least 4 hours or grout slump is not maintained between 10 to 11 inches, place conventional grout in lifts not exceeding 5 feet 4 inches.
- d. Consolidate conventional grout lift and reconsolidate after initial settlement before placing next lift. For grout pours that are 12 inches or less in height, consolidate and reconsolidate grout by mechanical vibration or puddling. For grout pours that are greater than 12 inches in height, consolidate and reconsolidate grout by mechanical vibration. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation. If previous lift is not permitted to set, dip vibrator into previous lift. Do not insert

vibrators into lower lifts that are in a semi-solidified state. If lower lift sets prior to placement of subsequent lift, form a grout key by terminating grout a minimum of 1-1/2 inch below a mortar joint. Vibrate each vertical cell containing reinforcement in partially grouted masonry. Do not form grout keys within beams.

- e. If the masonry has cured 4 hours, place self-consolidating grout (SCG) in lifts not exceeding the pour height. If masonry has not cured for at least 4 hours, place SCG in lifts not exceeding 5 feet 4 inches. Do not mechanically consolidate self-consolidating grout. Place self-consolidating grout in accordance with manufacturer's recommendations.
- f. Upon completion of each day's grouting, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.4.3 Joint Reinforcement Installation

Install joint reinforcement at 16 inches on center unless otherwise indicated. Lap joint reinforcement not less than 6 inches. Install prefabricated sections at corners and wall intersections. Place the longitudinal wires of joint reinforcement in mortar beds to provide not less than 5/8 inch cover to either face of the unit.

3.4.4 Bond Beams

Reinforce and grout bond beams as indicated and as described in paragraphs above. Install grout barriers under bond beam units to retain the grout as required, unless wall is fully grouted or solid bottom units are used. For high lift grouting in partially grouted masonry, provide grout retaining material on the top of bond beams to prevent upward flow of grout. Ensure that reinforcement is continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated.

3.5 APPLICATION

3.5.1 Interface with Other Products

3.5.1.1 Built-In Items

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in as the masonry work progresses. Fully embed anchors, ties and joint reinforcement in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout, unless otherwise indicated.

3.5.1.2 Door and Window Frame Joints

On the exposed interior and exterior sides of exterior frames, rake joints between frames and abutting masonry walls to a depth of 3/8 inch.

3.5.1.3 Bearing Plates

Set bearing plates for beams, joists, joist girders and similar structural members to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Provide bedding mortar and

non-shrink grout s specified in Section 03 31 30 MARINE CONCRETE.

3.5.2 Tolerances

Lay masonry plumb, true to line, with courses level within the tolerances of TMS MSJC, Article 3.3 F.

3.6 FIELD QUALITY CONTROL

3.6.1 Tests

3.6.1.1 Field Testing of Mortar

Perform mortar testing at the following frequency: 1 times per day. For each required mortar test, provide a minimum of three mortar samples. Perform initial mortar testing prior to construction for comparison purposes during construction.

Prepare and test mortar samples for mortar aggregate ratio in accordance with ASTM C780 Appendix A4. Prepare and test mortar compressive strength specimens in accordance with ASTM C780 Appendix A6.

3.6.1.2 Field Testing of Grout

- a. Perform grout testing at the following frequency: 2 times per day. For each required grout property to be evaluated, provide a minimum of three specimens.
- b. Sample and test conventional and self-consolidating grout for compressive strength and temperature in accordance with ASTM C1019.
- c. Evaluate slump in conventional grout in accordance with ASTM C1019.
- d. Evaluate slump flow and visual stability index of self-consolidating grout in accordance with ASTM C1611/C1611M.

3.6.1.3 Prism Tests

Perform at least one prism test sample for each 5,000 square feet of wall but not less than three such tests for any building. Evaluate three prisms in each test. Fabricate, store, handle, and test prisms in accordance with ASTM C1314.

Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. If the compressive strength of any prism falls below the specified value by more than 500 psi, take steps to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, take three specimens for each prism test more than 500 psi below the specified value. Masonry in the area in question will be considered structurally adequate if the average compressive strength of three specimens is equal to or exceeds the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results will be permitted.

3.6.1.4 Single-Wythe Masonry Wall Water Penetration Test

Prior to start of field construction of the single-wythe concrete masonry wall, perform masonry wall water penetration test on mock-up wall assemblies consisting of the identical design, materials, mix, and construction methods as the actual wall construction and in accordance with ASTM E514/E514M. Prepare a minimum of three specimens and cure for minimum 28 days prior to testing. Construct panels by the same methods, processes, and applications to be used on the project's construction site. Spray test for 6 hours on each specimen. If water is visible on back of test panels during the test and areas of dampness on the backside of the test panels do not exceed 25 percent of the wall area, the panels will be considered to have passed. Dampness is defined as any area of surface darkening or discoloration due to moisture penetration or accumulation below the observed surface.

Construct additional test panels for each failed test performed until three test panels pass the test. Factors that can affect test performance include materials, mixing, and quality of application and workmanship. Materials, mixing, and methods adjustments may be necessary in order to provide construction that passes the water penetration test. Document and record the test specimen construction materials and application and provide written test report in accordance with ASTM E514/E514M, supplemented by a detailed discussion of the specifics of test panel construction, application methods and processes used, quality of construction, and any variances or deviations that may have occurred between test panels during test panel construction. For failed test panels, identify in the supplemental report the variances, deficiencies or flaws that contributed to test panel failure and itemize the precautions to be taken in field construction of the masonry wall to prevent similar deficiencies and assure the wall construction replicates test panel conditions that pass the water penetration test. Submit the complete, certified test report, including supplemental report, to the Contracting Officer prior to start of single-wythe concrete masonry wall construction. Significant changes to materials, proportions, or construction techniques from those used in the passing water penetration test are grounds for performing new tests, at the discretion of the Contracting Officer.

3.6.2 Special Inspection

Perform special inspections and testing in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

3.7 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs and splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, rake out defects in joints of masonry to be exposed or painted, fill with mortar, and tool to match existing joints. Immediately after grout work is completed, remove scum and stains that have percolated through the masonry work using a low pressure stream of water and a stiff bristled brush. Do not clean masonry surfaces, other than removing excess surface mortar, until mortar in joints has hardened. Leave masonry surfaces clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Do not use metal tools and metal brushes for cleaning.

3.7.1 Dry-Brushing Concrete Masonry

Dry brush exposed concrete masonry surfaces at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.8 CLOSE-OUT TAKE-BACK PROGRAM

Collect information from manufacturer for take-back program options. Set aside masonry units, full and partial scrap packaging to be returned to manufacturer for recycling into new product. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

3.9 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane to protect from moisture intrusion when work is not in progress. Continue covering the top of the unfinished walls until the wall is waterproofed with a complete roof or parapet system. Extend covering a minimum of 2 feet down on each side of the wall and hold securely in place. Before starting or resuming work, clean top surface of masonry in place of loose mortar and foreign material.

-- End of Section --

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SECTION 05 05 20.00 27

POST-INSTALLED CONCRETE AND MASONRY ANCHORS

02/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

- | | |
|-----------|--|
| ACI 355.2 | (2007) Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary |
| ACI 355.4 | (2011) Qualification of Post-Installed Adhesive Anchors in Concrete (ACI 355.4) and Commentary |

ASTM INTERNATIONAL (ASTM)

- | | |
|-----------------|---|
| ASTM A153/A153M | (2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A193/A193M | (2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications |
| ASTM A615/A615M | (2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM E488/E488M | (2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements |
| ASTM F1554 | (2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength |

INTERNATIONAL CODE COUNCIL (ICC)

- | | |
|---------|------------------------------------|
| ICC IBC | (2021) International Building Code |
|---------|------------------------------------|

U.S. ARMY CORPS OF ENGINEERS (USACE)

- | | |
|------------|--|
| EM 385-1-1 | (2014) Safety -- Safety and Health Requirements Manual |
|------------|--|

1.2 APPLICABILITY

This guide specification covers the requirements for all anchors that are

post-installed into hardened concrete, concrete masonry, or brick. This guide specification does not cover through bolts, powder or pneumatic actuated nails, or cast in anchors. Refer to Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS for requirements of through bolts, powder or pneumatic actuated nails, or cast in anchors.

1.3 DEFINITIONS

1.3.1 Anchor

"Anchor" includes steel elements post-installed into hardened concrete, concrete masonry, or brick and used to transmit applied loads.

1.3.2 Periodic Special Inspections

"Periodic Special Inspection" as used herein means that, as a minimum, the Post-Installed Anchor Special Inspector must perform inspections in accordance with this specification.

1.3.3 Continuous Special Inspections

"Continuous Special Inspection" as used herein means that the Post-Installed Anchor Special Inspector observes the drilling and cleaning of holes, the injection of adhesive into the holes, and the insertion of anchors into the holes. When applicable for the type of installation, or as indicated in the project drawings, "Continuous Special Inspection" also includes observation of measures to secure the anchor during the adhesive curing period.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installer Qualifications

Post-Installed Anchor Special Inspector Qualifications

SD-03 Product Data

Mechanical Anchors in Concrete; G

Adhesive Anchor System in Concrete; G

Mechanical and Adhesive Anchors in Masonry; G

Non-Shrink, Non-Metallic Grout

SD-06 Test Reports

Post-Installed Anchor Special Inspections Report

SD-07 Certificates

Post-Installed Anchor Certification

SD-08 Manufacturer's Instructions

Manufacturer's Printed Installation Instructions

Non-Shrink, Non-Metallic Grout

Manufacturer's Material Safety Data Sheets

1.5 QUALITY ASSURANCE

Perform all work in accordance with EM 385-1-1 and all manufacturer's instructions and recommendations. To protect personnel from overexposure to toxic materials, conform to the applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation. Submit the MSDS for epoxies and other potentially hazardous materials.

1.5.1 Qualifications

The submittals must identify individuals who will be working on this contract and their relevant experience and training. Do not make changes in approved personnel without prior approval of the Contracting Officer.

1.5.1.1 Installer Qualifications

Each worker engaged in the installation of post-installed anchors must have satisfactorily completed an applicable certification program or equivalent instruction program through the manufacturer or manufacturer's representative for all anchoring products they will install. A manufacturer's representative must train all installers per the installation instructions as listed in the ICC-ES Evaluation Report for the anchor being installed. Training must consist of a review and performance test of the complete installation process, including but not limited to:

- (1) Hole drilling procedure
- (2) Hole preparation & cleaning technique
- (3) Adhesive injection technique & dispenser training / maintenance
- (4) Anchor/threaded rod preparation and installation
- (5) Rebar dowel preparation and installation
- (6) Proof loading/torquing
- (7) Installation in horizontal and upward orientations

Submit certification for each worker showing that they have completed the above training within three years prior to onsite work. Certification must include organization or manufacturer's name, instructor's name and qualifications, trainee's name, list of instruction received, date of instruction, and confirmation of successful performance tests.

1.5.1.2 Post-Installed Anchor Special Inspector Qualifications

The Contractor must retain the services of a third party Special Inspector independent of the installing contractor and manufacturer. The

individual(s) who perform special inspections for post-installed anchors must meet all Installer Qualification requirements and have a minimum of 3 years of experience as a Special Inspector on previous projects involving similar scope of work. Submit resumes, pertinent information, past experience, and training.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Packing, Shipping, Handling, and Unloading

Deliver products to job site in manufacturer's or distributor's original packaging undamaged, complete with installation instructions. Inspect materials delivered to site for damage. Unload and store with minimal handling.

1.6.2 Storage

Protect, store, and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration. Do not allow chemical materials to freeze. Remove materials that have not be stored in accordance with the manufacturer's recommendations, including expired materials, from the job site.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Post-Installed Anchors

Provide anchors of the type, effective embedment, and diameter indicated on contract drawings. Minimum spacing and concrete edge distances must be as shown on contract drawings. Design values listed must be as tested according to ASTM E488/E488M for the substrate type, substrate moisture condition, concrete aggregate type (normal weight or lightweight concrete), and concrete/masonry strength. Minimum ultimate strength tension and shear values must be as indicated on contract drawings. If more than one type of anchor is to be used on a project, clearly indicate on the submittal where each type of anchor will be used.

2.1.1.1 Post-Installed Anchor Certification

Submit product information with recommended design values and physical characteristics for each type anchor shown on the drawings.

Provide certified test reports showing compliance with specified performance characteristics and physical properties. Anchors must have one of the following certifications:

- (1) ICC-ES Evaluation Report indicating conformance with current applicable ICC ES Acceptance Criteria
- (2) Third party Evaluation Report in conformance with ACI 355.2 or ACI 355.4, as applicable. Third party must be accredited under ISO/IEC 17025 by a recognized accreditation body conforming to the requirements of ISO/IEC 17011 in accordance with ACI 355.4."

2.1.1.2 Manufacturer's Printed Installation Instructions

Submit manufacturer's instructions for each anchor type shown on the

drawings.

2.1.1.3 Mechanical Anchors in Concrete

Anchors must have been tested and qualified for performance in cracked and uncracked concrete in accordance with ACI 355.2.

Anchors must be galvanized in accordance with ASTM A153/A153M or stainless steel in accordance with ASTM A193/A193M unless otherwise indicated.

2.1.1.4 Adhesive Anchor System in Concrete

Use an adhesive to bond steel anchors to concrete. The adhesive must be a moisture insensitive, structural adhesive. Anchors must have been tested and qualified for performance in cracked and uncracked concrete, horizontal and overhead applications, and long term creep in accordance with ACI 355.4.

Threaded rod anchors must meet the requirements of ASTM F1554 Grade 55, unless otherwise indicated. Threaded rods must be galvanized in accordance with ASTM A153/A153M or stainless steel in accordance with ASTM A193/A193M unless otherwise indicated. Reinforcing bars must meet the requirements of ASTM A615/A615M Grade 60.

Adhesive anchors must have the below characteristic bond strengths for uncracked and cracked concrete in 4,000 psi concrete with maximum short term temperatures of 130 degrees F and maximum long term temperatures of 110 degrees F:

ANCHOR	Tau,uncr (characteristic bond strength, uncracked concrete)	Tau,cr (characteristic bond strength, cracked concrete)
	(psi)	(psi)
3/8" diameter threaded rod	2380	1280
1/2" diameter threaded rod	2300	1270
5/8" diameter threaded rod	2210	1260
3/4" diameter threaded rod	2130	1250
7/8" diameter threaded rod	2040	1240
1" diameter threaded rod	1960	1240
# 3 reinforcing bar	1770	1350
# 4 reinforcing bar	1740	1360
# 5 reinforcing bar	1720	1390
#6 reinforcing bar	1690	1410

ANCHOR	Tau,uncr (characteristic bond strength, uncracked concrete)	Tau,cr (characteristic bond strength, cracked concrete)
	(psi)	(psi)
3/8" diameter threaded rod	2380	1280
# 7 reinforcing bar	1670	1410
# 8 reinforcing bar	1640	1420
# 9 reinforcing bar	1620	1390
# 10 reinforcing bar	1590	1340

2.1.1.5 Mechanical and Adhesive Anchors in Masonry

Anchors must have been tested and qualified, by a third party, specifically for performance in filled concrete masonry to match the project's actual base material.

Adhesives must be moisture insensitive, low creep, structural adhesive. Threaded rods must meet the requirements of ASTM F1554 Grade 55, unless otherwise indicated.

Anchors must be galvanized in accordance with ASTM A153/A153M or stainless steel in accordance with ASTM A193/A193M unless otherwise indicated.

2.2 EQUIPMENT

Assemble at the site of the work, sufficient equipment that is dependable, appropriate and adequate to accomplish the work specified. Maintain the equipment in good working condition.

PART 3 EXECUTION

3.1 ANCHORING AND REINFORCING

Install anchors in accordance with the spacing and edge clearances indicated on the drawings. Anchor capacity is also highly dependent on proper installation. Follow all manufacturer and Evaluation Report installation instructions.

3.1.1 Drilling and Installing Mechanical Anchors

Drill holes for anchors using drilling equipment and bits suitable for the intended purpose, in accordance with Manufacturer's published installation instructions. Diameter of holes must be as recommended by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes must be drilled perpendicular to the concrete surface. Deviations more than 6 degrees from perpendicular are not acceptable. Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Mechanical anchors must not be installed in concrete that is less than 7 days old.

Clean holes, install anchors and set anchors in place in accordance with the manufacturer's recommendations. Protect threads and anchor from

damage during anchor installation. Ensure proper embedment and placement in accordance with contract documents and all other work. Aim wedges away from any concrete edges that are less than 9 inches from centerline of hole.

Tighten nuts against smooth washers to the manufacturer's recommended torque, using a calibrated torque wrench. Following attainment of 10 percent of the specified torque, 100 percent of the specified torque must be reached within 7 or less complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor must be removed and replaced unless otherwise directed by the Engineer of Record.

3.1.2 Drilling and Installing Adhesive Anchors

Drill holes for anchors using drilling equipment and bits suitable for the intended purpose, in accordance with Manufacturer's Printed Installation Instructions and Evaluation Report installation instructions. Diameter of holes must be as recommended by the anchor manufacturer. Unless otherwise shown on the drawings, all holes must be drilled perpendicular to the concrete surface. Deviations more than 10 degrees from perpendicular are not acceptable. Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Adhesive anchors must not be installed in concrete that is less than 21 days old.

Clean holes, place grout, and install anchors in accordance with anchor manufacturer's recommendations. Remove excess adhesive after the anchor has been set in place. Remove spills on adjacent surfaces. Protect threads and anchor from damage during anchor installation. Ensure proper embedment and placement in accordance with contract documents and all other work. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

Adhesives must be stored at temperatures prescribed by the manufacturer and must not be used beyond the expiration date.

3.1.3 Unused or Repairs to Drilled Holes

Any holes made for anchors that are not used must be filled with non-shrink, non-metallic grout suitable for the orientation and size of hole and have a minimum compressive strength of 4000 psi. Repair must completely fill hole and be flush with existing concrete or masonry. Place in accordance with manufacturer's recommended instructions. Final anchor positions must not be within 1 inch of repair patches.

3.2 EMBEDDED ITEMS

Existing reinforcing bars or other embedded items in the structure may conflict with specified anchor locations. Existing reinforcing and embedded items must not be damaged during installation of post-installed anchors.

The contractor must review the project drawings and must use Radar detection systems (such as Hilti Ferrosan), X-Ray, or other appropriate means to accurately locate the position of reinforcing bars and embedded items at the locations of the anchors in the field.

Create a template at each anchor connection location prior to fabricating

holes in connection plates. Template must be made by locating existing reinforcing with an approved reinforcement detection system.

3.3 TESTS AND INSPECTIONS

3.3.1 Mechanical Anchors

For mechanical anchors, periodic special inspections are required. Inspections must be in accordance with ICC IBC and the Evaluation Report.

Mechanical Anchors must be inspected during installation, to verify anchor type, anchor dimensions, base material type, drill bit, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, base material thickness, base material age, effective embedment, tightening torque, adherence to the manufacturer's printed installation instructions, and any additional items recommended in the Evaluation Report.

For mechanical anchors whose strength is dependent on a minimum installation torque, the installer under the supervision of the Special Inspector must torque test the anchors with a calibrated torque wrench. Perform torque testing immediately on the first three anchors of each type and size, for each installer, and a minimum of 5 percent of randomly selected anchors. Anchor selection will be determined by the Post-Installed Anchor Special Inspector.

For mechanical anchors whose strength is not dependent on a minimum installation torque, the Special Inspector must perform proof loading on the first three anchors of each type and size, for each installer and a minimum of 5 percent of randomly selected anchors. Anchor selection will be determined by the Post-Installed Anchor Special Inspector. Perform confined tension proof load testing in accordance with ASTM E488/E488M. Use incremental loading for tensile test. Maintain proof load for a minimum of 10 seconds. Consider anchors to have failed if displacement exceeds 0.1 inch D/10, where D is the nominal anchor diameter, or if any of the failure modes listed in ASTM E488/E488M occur.

Proof loads must be the minimum of the value shown on the Drawings, the values shown in the table below, or 50 percent of the tension capacity of the anchor:

ANCHOR	EFFECTIVE EMBEDMENT	CONFINED TENSION PROOF LOAD
	(inches)	(pounds)
Concrete Screw Anchor, 1/2" diameter	2 1/4" to 4 1/4" in Concrete	1250
Concrete Screw Anchor, 5/8" diameter	3 1/4" to 5" in Concrete	2460
Concrete Screw Anchor, 3/4" diameter	4" to 5" in Concrete	3320
Masonry Screw Anchor, 1/2" diameter	2 1/4" to 4 1/4" in Masonry	380
Masonry Screw Anchor, 5/8" diameter	3 1/4" to 5" in Masonry	930

ANCHOR	EFFECTIVE EMBEDMENT	CONFINED TENSION PROOF LOAD
	(inches)	(pounds)
Masonry Screw Anchor, 3/4" diameter	4" to 6 1/4" in Masonry	930

3.3.2 Adhesive Anchors

For adhesive anchors, periodic special inspection are required as a minimum. Where adhesive anchors are used to resist sustained tension in horizontal or upwardly inclined orientations, or where the findings of the Evaluation Report for the adhesive anchor product require it, continuous special inspection is needed. Inspections must be in accordance with ICC IBC and the Evaluation Report.

Adhesive anchors must be inspected during installation, to verify anchor type, anchor dimensions, base material type, base material age, drill bit, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, base material thickness, effective embedment, tightening torque, adhesive mixing, filling of the hole with adhesive, adherence to the manufacturer's printed installation instructions, and any additional items recommended in the Evaluation Report.

The Special Inspector must perform proof loading on the first three anchors of each type and size, for each installer, and a minimum of 5 percent of randomly selected anchors. Anchor selection will be determined by the Post-Installed Anchor Special Inspector. Perform confined tension proof load testing in accordance with ASTM E488/E488M. Use incremental loading for tensile test. Maintain proof load for a minimum of 10 seconds. Consider anchors to have failed if displacement exceeds 0.1 inch D/10, where D is the nominal anchor diameter, or if any of the failure modes listed in ASTM E488/E488M occur.

Adhesive anchors and capsule anchors must not be torque tested.

Proof loads must be the minimum of the value shown on the Drawings, the values shown in the table below, or 50 percent of the tension capacity of the anchor:

ANCHOR	EFFECTIVE EMBEDMENT	CONFINED TENSION PROOF LOAD
	(inches)	(pounds)
Adhesive anchor, 1/2" diameter rod	6" to 10"	7,940
Adhesive anchor, 5/8" diameter rod	7 1/2" to 12 1/2"	12,300
Adhesive anchor, 3/4" diameter rod	9" to 15"	17,570

3.3.3 Action Required from Failed Tests/Inspections

Immediately report failed anchor locations and test results to the

Contracting Officer. Anchors that fail to meet proof/torque load or installation requirements must be regarded as malfunctioning. Do not re-use holes unless specifically allowed by manufacturer's published instructions and approved by the Post-Installed Anchor Special Inspector.

If any of the tested anchors fail to achieve the specified torque or proof load within the limits of the contract documents, test a minimum of two adjacent anchors for each anchor that fails.

Continuously special inspect and proof load/torque test any replacement anchors.

Fill unused anchor holes and patch failed anchor locations in accordance with this specification. Prior to performing the repair, the Contractor must submit to the Contracting Officer for approval, the proposed fill and patch materials.

Additional tests, repairs, delays, or modification of work to accommodate failed tests will be at no cost to the Government.

3.3.4 Post-Installed Anchor Special Inspections Report

Report the results of all inspections weekly. Submit report as an electronic PDF file to the Contracting Officer for review by the Engineer of Record. The report must include the following:

- (1) Exact locations of the inspected and tested work
- (2) Inspector's name
- (3) Date of inspection
- (4) Summary of work completed during the inspection period
- (5) Test results
- (6) Statement by the Special Inspector that clearly identifies the tested anchors as being acceptable or rejected.
- (7) Statement by the Special Inspector confirming that the materials and installation procedures conform with the approved contract documents and the manufacturer's published installation instructions.

3.4 DUST CONTROL

Control dust resulting from demolition to prevent the spread of dust and avoid creation of a nuisance in the surrounding area. Do not use water when it will result in, or create, hazardous or objectionable conditions such as ice, flooding, or pollution.

-- End of Section --

SECTION 05 05 23.16

STRUCTURAL WELDING
08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2016) Specification for Structural Steel Buildings

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189 (2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (2012) Standard Symbols for Welding, Brazing and Nondestructive Examination

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding Code - Steel

AWS QC1 (2016) Specification for AWS Certification of Welding Inspectors

AWS Z49.1 (2012) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM E165/E165M (2018) Standard Practice for Liquid Penetrant Examination for General Industry

ASTM E709 (2021) Standard Guide for Magnetic Particle Testing

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Welding Quality Assurance Plan

SD-03 Product Data

Welding Procedure Qualifications

Welder, Welding Operator, and Tacker Qualification

Previous Qualifications

Pre-Qualified Procedures

Welding Electrodes and Rods

SD-06 Test Reports

Nondestructive Testing

Weld Inspection Log

SD-07 Certificates

Certified Welding Inspector

Nondestructive Testing Personnel

1.3 QUALITY ASSURANCE

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding must record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the procedure qualification records for each type of welding being performed. Submission of the welder, welding operator, or tacker qualification test records is also required. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.3.1 Previous Qualifications

Welding procedures previously qualified by test in accordance with AWS D1.1/D1.1M, may be accepted for this contract without re-qualification, upon receipt of the test results, if the following conditions are met:

- a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- c. The welder, welding operator, and tacker qualification tests conform

to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.3.2 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification. Submit for approval a listing or an annotated drawing to indicate the joints not pre-qualified. Procedure qualification is mandatory for these joints.

1.3.3 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract must be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used within the applicable essential variables for welder qualification.

1.3.3.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

- a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.
- b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.3.3.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names and certification that each individual is qualified as specified. State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.3.3.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

- a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.
- b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these

specifications.

- c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.
- d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability or there has been a gap greater than 6 months since he/she last used the process. In such a case, the tacker is required to pass the prescribed tack welding test.

1.3.4 Inspector Qualification

Submit certificates indicating that certified welding inspectors meet the requirements of AWS QC1. Submit qualifications for nondestructive testing personnel in accordance with the requirements of ANSI/ASNT CP-189 for Levels I or II in the applicable nondestructive testing method. Level I inspectors must have direct supervision of a Level II inspector.

1.3.5 Symbols and Safety

Use symbols in accordance with AWS A2.4, unless otherwise indicated. Follow safe welding practices and safety precautions during welding in conformance with AWS Z49.1.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

2.1.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (submitted for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and nondestructive testing; welding schedule; and other items deemed necessary

by the attendees.

2.2 WELDING EQUIPMENT AND MATERIALS

Provide all welding equipment, welding electrodes and rods, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator. Provide welding equipment and materials that comply with the applicable requirements of AWS D1.1/D1.1M. Submit product data on welding electrodes and rods.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.1.2 Identification

Identify all welds in one of the following ways:

- a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.
- b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. A Certified Welding Inspector must perform visual inspection on 100 percent of all welds. Document this inspection in the Visual Weld Inspection Log. Test 50% of CJP welds using ultrasonic testing per Table 6.2 or 6.3 of AWS D1.1/D1.1M. Randomly test 50% of all PJP and fillet welds or as indicated by magnetic particle or dye penetrant testing. Verify the welds conform to paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E165/E165M, and ASTM E709. Submit a Welding Quality Assurance Plan and records of tests and inspections.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Submit all records of nondestructive testing.

3.3.1 Nondestructive Testing

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present. Submit all records of nondestructive testing in accordance with paragraph STANDARDS OF ACCEPTANCE.

3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds must meet the inspection requirements for the original welds.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL
08/18, CHG 1: 11/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2016) Code of Standard Practice for Steel Buildings and Bridges
AISC 325	(2017) Steel Construction Manual
AISC 326	(2009) Detailing for Steel Construction
AISC 360	(2016) Specification for Structural Steel Buildings
AISC DESIGN GUIDE 10	(1997) Erection Bracing of Low-Rise Structural Steel Buildings

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	(2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel
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AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B46.1	(2020) Surface Texture, Surface Roughness, Waviness and Lay
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AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
AWS QC1	(2016) Specification for AWS Certification of Welding Inspectors

ASTM INTERNATIONAL (ASTM)

ASTM A6/A6M	(2021) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A29/A29M	(2020) Standard Specification for General Requirements for Steel Bars, Carbon and

	Alloy, Hot-Wrought
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143/A143M	(2007; R 2020) Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A500/A500M	(2021a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(2020) Standard Specification for Structural Steel Shapes
ASTM B695	(2004; R 2016) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C827/C827M	(2016) Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F436/F436M	(2019) Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
ASTM F844	(2019) Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F959/F959M	(2017a) Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural

Fasteners, Inch and Metric Series

ASTM F1136/F1136M	(2011) Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F2329/F2329M	(2015) Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F2833	(2011; R 2017) Standard Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC Paint 20	(2019) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)
SSPC Paint 29	(2002; E 2004) Zinc Dust Sacrificial Primer, Performance-Based
SSPC SP 3	(2018) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2019) Structural Engineering
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR Part 1926, Subpart R	Steel Erection
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Erection and Erection Bracing Drawings

SD-02 Shop Drawings

Fabrication Drawings; G

SD-03 Product Data

Shop Primer

Welding Electrodes and Rods

Direct Tension Indicator Washers

Non-Shrink Grout

SD-06 Test Reports

Weld Inspection Reports

Direct Tension Indicator Washer Inspection Reports

Bolt Testing Reports

Embrittlement Test Reports

SD-07 Certificates

Steel

Galvanizing

Welding Procedures and Qualifications

Welding Electrodes and Rods

Certified Welding Inspector

NDT Technician

Welding Procedure Specifications (WPS)

Recycled Content; S

Regional Material; S

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Sourcing of Raw Materials

Provide recycled content certifications of applicable materials including structural steel and structural steel tubing and structural steel pipe.

Provide regional material certifications of applicable materials.

1.4 QUALITY ASSURANCE

1.4.1 Preconstruction Submittals

1.4.1.1 Erection and Erection Bracing Drawings

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing. The erection drawings must conform to AISC 303.

1.4.2 Fabrication Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 303, AISC 326 and AISC 325. Fabrication drawings must not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Clearly highlight any deviations from the details shown on the contract drawings highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.4.3 Certifications

1.4.3.1 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welder or welding operator is more than 6 months old, the welding operator's qualification certificate must be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer or galvanizing, complete and ready for use. Provide structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing in accordance with AISC 303, AISC 360, and UFC 3-301-01 except as modified in this contract.

2.2 STEEL

2.2.1 Structural Steel

Wide flange and WT shapes, ASTM A992/A992M. Angles, Channels and Plates, ASTM A36/A36M. Provide structural steel containing a minimum of 80 percent recycled content. Submit data identifying percentage of recycled content for structural steel.

2.2.2 Structural Steel Tubing

ASTM A500/A500M, Grade C. Provide structural steel tubing containing a minimum of 25 percent recycled content. Submit data identifying percentage of recycled content for structural steel tubing.

2.2.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B, weight class STD (Standard) or as indicated. Provide steel pipe containing a minimum of 50 percent recycled content. Submit data identifying percentage of recycled content for steel pipe.

2.3 BOLTS, NUTS, AND WASHERS

2.3.1 Common Grade Bolts

2.3.1.1 Bolts

ASTM A307, Grade A, plain finish hot dipped zinc coating. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.3.1.2 Nuts

ASTM A563, Grade A, heavy hex style.

2.3.1.3 Washers

ASTM F844.

2.3.2 High-Strength Bolts

High strength bolts and nuts must be shipped together in the same shipping container. Fasteners indicated to be galvanized shall be tested by the supplier to show that the galvanized nut with the supplied lubricant provided may be rotated from the snug tight condition well in excess of the rotation required for pretensioned installation without stripping. The supplier shall supply nuts that have been lubricated and tested with the supplied bolts.

2.3.2.1 Bolts

ASTM F3125/F3125M, Grade A325M A325, Type 1 Heavy Hex Head Style, plain finish hot dipped zinc coating.

2.3.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.3.2.3 Direct Tension Indicator Washers

ASTM F959/F959M. Provide ASTM B695, Class 55, Type 1 galvanizing. Submit product data for direct tension indicator washers.

2.3.2.4 Washers

ASTM F436/F436M, plain carbon steel.

2.3.3 Foundation Anchorage

2.3.3.1 Anchor Rods

ASTM F1554 Gr 36, unless noted otherwise on the drawings, Class 1A.

2.3.3.2 Anchor Nuts

ASTM A563, Grade A, hex style.

2.3.3.3 Anchor Washers

ASTM F844.

2.3.3.4 Anchor Plate Washers

ASTM A36/A36M.

2.4 STRUCTURAL STEEL ACCESSORIES

2.4.1 Welding Electrodes and Rods

AWS D1.1/D1.1M. Submit product data for welding electrodes and rods.

2.4.2 Non-Shrink Grout

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. Submit product data for non-shrink grout.

2.4.3 Welded Shear Stud Connectors

ASTM A29/A29M, Grades 1010 through 1020. AWS D1.1/D1.1M, Table 7.1, Type B.

2.5 GALVANIZING

ASTM F2329/F2329M, ASTM F1136/F1136M, ASTM F2833 or ASTM B695 for threaded parts or ASTM A123/A123M for structural steel members, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

Fabrication must be in accordance with the applicable provisions of AISC 325. Fabrication and assembly must be done in the shop to the greatest extent possible. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member.

Compression joints depending on contact bearing must have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends must be square within the tolerances for milled ends specified in ASTM A6/A6M.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

2.6.1 Markings

Prior to erection, identify members by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections must be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.6.2 Shop Primer

SSPC Paint 20 or SSPC Paint 29, (zinc rich primer). Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, surfaces designed as part of a composite steel concrete section, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking and shear studs are to be welded). If flash rusting occurs, re-clean the surface prior to application of primer. Apply primer to a minimum dry film thickness of 2.0 mil. Submit shop primer product data.

Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Contracting Officer. Repair damaged primed surfaces with an additional coat of primer.

2.6.2.1 Cleaning

SSPC SP 6/NACE No.3, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.7 DRAINAGE HOLES

Drill adequate drainage holes to eliminate water traps. Hole diameter must be 1/2 inch and location indicated on the detail drawings. Hole size and locations must not affect the structural integrity.

PART 3 EXECUTION

3.1 ERECTION

- a. Erection of structural steel, except as indicated in item b. below, must be in accordance with the applicable provisions of AISC 325, AISC 303 and 29 CFR Part 1926, Subpart R.
- b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), erect the structure in accordance with AISC DESIGN GUIDE 10.

After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.1.1 STORAGE

Store the material out of contact with the ground in such manner and location as to minimize deterioration.

3.2 CONNECTIONS

Except as modified in this section, design connections indicated in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Holes must not be cut or enlarged by burning. Bolts, nuts, and washers must be clean of dirt and rust, and lubricated immediately prior to installation.

3.2.1 Common Grade Bolts

Tighten ASTM A307 bolts to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.2.2 High-Strength Bolts

Provide direct tension indicator washers in all ASTM F3125/F3125M, Grade A325 and Grade A490 bolted connections. Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, fully tension bolts, progressing from the most rigid part of a connection to the free edges.

Fastener components shall be protected from dirt and moisture in closed containers at the site of the installation. Fastener components that are not incorporated into the work shall be returned to protected storage at the end of the work shift.

3.2.2.1 Installation of Direct Tension Indicator Washers (DTIW)

Where possible, install the DTIW under the bolt head and tighten the nut. If the DTIW is installed adjacent to the turned element, provide a flat washer between the DTIW and nut when the nut is turned for tightening, and between the DTIW and bolt head when the bolt head is turned for tightening. In addition to the DTIW, provide flat washers under both the bolt head and nut when ASTM F3125/F3125M, Grade A490 bolts are used.

3.3 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors is not permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officer.

3.4 WELDING

Welding must be in accordance with AWS D1.1/D1.1M. Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

Develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Submit for approval all WPS, whether prequalified or qualified by testing.

3.4.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.5.1 Field Priming

Field prime steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat must be cleaned and primed with paint of the same quality as that used for the shop coat.

3.6 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. Notify the Contracting Officer in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of the inspection.

3.7.1 Welds

3.7.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. A Certified Welding Inspector must perform visual inspection on 100 percent of all welds. Document this inspection in the Visual Weld Inspection Log. Submit certificates indicating that certified welding inspectors meet the requirements of AWS QC1.

3.7.1.2 Nondestructive Testing

Nondestructive testing must be in accordance with AWS D1.1/D1.1M. Ultrasonic testing must be performed in accordance with Table 6.2 or 6.3 of AWS D1.1/D1.1M. Test locations must be as indicated. All personnel performing NDT must be certified in accordance with ANSI/ASNT CP-189 in the method of testing being performed. Submit certificates showing compliance with ANSI/ASNT CP-189 for all NDT technicians. If more than 20 percent of welds made by a welder contain defects identified by testing, then all groove welds made by that welder must be tested by ultrasonic testing, and all fillet welds made by that welder must be inspected by magnetic particle testing (MT) or dye penetrant testing (PT) as approved by the Contracting Officer. When groove welds made by an individual welder are required to be tested, magnetic particle or dye penetrant testing may be used only in areas inaccessible to ultrasonic testing. Retest all repaired areas. Submit weld inspection reports.

Testing frequency: Provide the following types and number of tests:

<u>Test Type</u>	<u>Number of Tests</u>
Ultrasonic	50 percent of CJP Welds
Magnetic Particle	50 percent of PJP and Fillet Welds
Dye Penetrant	50 percent of PJP and Fillet Welds

3.7.2 Direct Tension Indicator Washers

3.7.2.1 Direct Tension Indicator Washer Compression

Test direct tension indicator washers in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap, as required by ASTM F959/F959M. Submit direct tension indicator washer inspection reports.

3.7.3 High-Strength Bolts

3.7.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension must be developed by tightening the nut. A representative of the manufacturer or supplier must be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements. Submit bolt testing reports.

3.7.3.2 Inspection

Inspection procedures must be in accordance with AISC 360. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

3.7.3.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. Provide the required access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations must be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, must be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

3.7.4 Testing for Embrittlement

ASTM A143/A143M for steel products hot-dip galvanized after fabrication.
Submit embrittlement test reports.

3.7.5 Inspection and Testing of Steel Stud Welding

Perform verification inspection and testing of steel stud welding conforming to the requirements of AWS D1.1/D1.1M, Stud Welding Clause. The Contracting Officer will serve as the verification inspector. Bend test studs that do not show a full 360 degree weld flash or have been repaired by welding as required by AWS D1.1/D1.1M, Stud Welding Clause. Studs that crack under testing in the weld, base metal or shank will be rejected and replaced by the Contractor at no additional cost.

-- End of Section --

SECTION 05 21 00

STEEL JOIST FRAMING
05/15, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding
Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon
Structural Steel

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1 (2016) Shop, Field, and Maintenance
Coating of Metals

SSPC Paint 15 (1999; E 2004) Steel Joist Shop
Primer/Metal Building Primer

SSPC SP 2 (2018) Hand Tool Cleaning

STEEL JOIST INSTITUTE (SJI)

SJI LOAD TABLES (2010; Errata 1 2011; Errata 2 2012) 42nd
Edition Catalog of Standard Specifications
Load Tables and Weight Tables for Steel
Joists and Joist Girders

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926 Safety and Health Regulations for
Construction

29 CFR 1926.757 Steel Erection; Open Web Steel Joists

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Welder Qualification

SD-02 Shop Drawings

Steel Joist Framing; G

SD-05 Design Data

Design Calculations; G

SD-06 Test Reports

Erection Inspection

Welding Inspections

SD-07 Certificates

Certification of Compliance

Recycled Content

Recycled Content of Steel Products; S

Regional Material; S

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Sourcing of Raw Materials

Provide recycled content certifications of applicable steel products.

Provide regional material certifications of applicable materials.

1.4 QUALITY ASSURANCE

Perform all work in compliance with the requirements set forth in 29 CFR 1926.

1.4.1 Drawing Requirements

Submit drawings of steel joist framing including fabrication, specifications for shop painting, and identification markings of joists. Show joist type and size, layout in plan, all applicable loads, deflection criteria, and erection details including methods of anchoring, framing at openings, type, size, and location and connections for and spacing of bridging, requirements for field welding, and details of accessories as applicable.

1.4.2 Certification of Compliance

Prior to construction commencement, submit certification for welder qualification, in compliance with AWS D1.1/D1.1M, welding operation, and

tacker, stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. Submit certification of compliance for the following:

- a. Steel Joist Institute Member Fabricator
- b. 29 CFR 1926
- c. 29 CFR 1926.757
- d. Statement from steel joist manufacturer, that work was performed in accordance with approved construction documents and with SJI standard specifications, in accordance with ICC IBC Section 1704.2.5.2.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, transport, and store joists in a manner to prevent damage affecting their structural integrity. Verify piece count of all joist products upon delivery and inspect all joists products for damage. Report any damage to the joist supplier. Store all items off the ground in a well drained location protected from the weather and easily accessible for inspection and handling. Store joists with top chord down and with joists in a vertical position. Store deep joists horizontally if they were shipped on their sides.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Designate steel joists on the drawings in accordance with the standard designations of the Steel Joist Institute. Joists of other standard designations or joists with properties other than those shown may be substituted for the joists designated provided the structural properties are equal to or greater than those of the joists shown and provided all other specified requirements are met.

2.2 STEEL JOISTS

Provide steel joists conforming to SJI LOAD TABLES. Design joists designated K, KCS, LH and DLH to support the loads given in the applicable standard load tables of SJI LOAD TABLES. Submit design calculations for special steel joists, net uplift loads, non-SJI standard details, and field splices. Include cover letter signed and sealed by the joist manufacturer's registered design professional.

2.2.1 Steel Joist Camber

Camber joists according to SJI LOAD TABLES or as otherwise indicated.

2.2.2 Special Steel Joists

Provide special joists and connections capable of withstanding the design loads indicated with a live-load deflection less than L/240 for roof joists and L/360 for floor joists.

2.2.3 Steel Joist Substitutes and Outriggers

Provide joist substitutes and outriggers conforming to SJI LOAD TABLES

with steel angle or channel members.

2.3 RECYCLED CONTENT

Provide products with an average recycled content of steel products of postconsumer recycled content plus one half of preconsumer recycled content not less than 25 percent.

2.4 ACCESSORIES AND FITTINGS

2.4.1 Bridging

Provide bridging of material, size, and type required by SJI LOAD TABLES for type of joist, chord size, spacing and span. Furnish additional erection bridging if required for stability.

2.4.2 Bearing Plates

Fabricate steel bearing plates from ASTM A36/A36M steel of size and thickness indicated.

2.4.3 Ceiling Extensions

Furnish ceiling extensions, either bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

2.5 SHOP PAINTING

SSPC Paint 15. Shop prime joists, except as modified herein, in accordance with SSPC PA 1. Clean joists in accordance with SSPC SP 2 before priming. If flash rusting occurs, re-clean the surface prior to application of primer. For joists which require finish painting under Section 09 90 00 PAINTS AND COATINGS, the primer paint must be compatible with the finish paint.

PART 3 EXECUTION

3.1 ERECTION

Install joists in conformance with SJI LOAD TABLES for the joist series indicated, and the requirements of 29 CFR 1926 and 29 CFR 1926.757. Handle and set joists avoiding damage to the members. Place the "tag end" of joists as shown on the joists placement plans. Ensure that square-end joists are erected right side up. Distribute temporary loads so that joist capacity is not exceeded. Remove damaged joists from the site, except when field repair is approved and such repairs are satisfactorily made in accordance with the manufacturer's recommendations. Do not repair, field modify, or alter any joists without specific written instructions from the Designer of Record and/or joist manufacturer.

Install and connect bridging concurrently with joist erection, before construction loads are applied. Do not apply loads to bridging. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams. Do not cut away vertical leg of bridging where bridging makes an elevation transition; weld a separate piece of bridging at the transition. Perform all welding in accordance with AWS D1.1/D1.1M.

3.2 BEARING PLATES

Provide bearing plates to accept full bearing after the supporting members have been plumbed and properly positioned, but prior to placing superimposed loads. The area under the plate must be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Provide bedding mortar and grout as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.3 PAINTING

3.3.1 Touch-Up Painting

After erection of joists, touch-up connections and areas of abraded shop coat with paint of the same type used for the shop coat.

3.3.2 Field Painting

Paint joists requiring a finish coat in conformance with the requirements of Section 09 90 00 PAINTS AND COATINGS.

3.4 VISUAL INSPECTIONS

Perform the following visual inspections:

- a. Verify that all joists are spaced properly.
- b. Verify that there is sufficient joist bearing on steel beams, concrete, and masonry.
- c. Verify all bridging lines are properly spaced and anchored.
- d. Verify that damage has not occurred to the joists during erection.
- e. Verify the joists are aligned vertically and there is no lateral sweep in the joists.
- f. Where concentrated loads are present on the joists verify that they are located in accordance with the joists placement plan.
- g. Verify welding of bridging and joist seats in accordance with AWS D1.1/D1.1M, Section 6. Perform erection inspection and field welding inspections with AWS certified welding inspectors.
- h. Verify proper bolting of diagonal bridging and joist seats where the bolts are snug-tight.

-- End of Section --

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SECTION 05 30 00

STEEL DECKS
05/15, CHG 2: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI D100 (2017) Cold-Formed Steel Design Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding Code - Steel

AWS D1.3/D1.3M (2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

ASTM A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A653/A653M (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A780/A780M (2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

ASTM A792/A792M (2010; R 2015) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

ASTM A1008/A1008M (2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

ASTM D746 (2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

ASTM D1056 (2014) Standard Specification for Flexible

Cellular Materials - Sponge or Expanded Rubber

ASTM D1149 (2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber

ASTM E84 (2020) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

FM DS 1-28R (1998) Data Sheet: Roof Systems

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20 (2019) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)

STEEL DECK INSTITUTE (SDI)

ANSI/SDI C (2017) Standard for Composite Steel Floor Deck - Slabs

ANSI/SDI NC (2017) Standard for Non-Composite Steel Floor Deck

ANSI/SDI QA/QC (2017) Standard for Quality Control and Quality Assurance for Installation of Steel Deck

ANSI/SDI RD (2017) Standard for Steel Roof Deck

SDI DDM04 (2015; Errata 1-3 2016; Add 1 2015; Add 2 20162006) Diaphragm Design Manual; 4th Edition

SDI DDP (1987; R 2000) Deck Damage and Penetrations

SDI MOC3 (2016) Manual of Construction with Steel Deck (3rd Edition)

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2019) Structural Engineering

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926 Safety and Health Regulations for Construction

UNDERWRITERS LABORATORIES (UL)

UL 580 (2006; Reprint Mar 2019) UL Standard for Safety Tests for Uplift Resistance of Roof

Assemblies

UL Fire Resistance

(2014) Fire Resistance Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G

SD-03 Product Data

Accessories

Deck Units

Galvanizing Repair Paint

Mechanical Fasteners

Touch-Up Paint

Welding Equipment

Welding Rods and Accessories

SD-05 Design Data

Deck Units; G

SD-07 Certificates

Powder-Actuated Tool Operator

Welder Qualifications

Welding Procedures

Fire Safety

Wind Storm Resistance

Manufacturer's Certificate

Stud Manufacture's Certification

Stud Manufacture's Test Reports

Recycled Content; S

Regional Material; S

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Sourcing of Raw Materials

Provide recycled content certifications of steel products.

Provide regional material certifications of steel products.

1.4 QUALITY ASSURANCE

1.4.1 Deck Units

Furnish deck units and accessory products from a manufacturer regularly engaged in manufacture of steel decking. Provide manufacturer's certificates attesting that the decking material meets the specified requirements.

1.4.2 Certification of Powder-Actuated Tool Operator

Provide manufacturer's certificate attesting that the operators are authorized to use the low velocity powder-actuated tool.

1.4.3 Qualifications for Welding Work

Follow Welding Procedures of AWS D1.3/D1.3M for sheet steel and AWS D1.1/D1.1M for stud welding.

Submit qualified Welder Qualifications in accordance with AWS D1.3/D1.3M for sheet steel and AWS D1.1/D1.1M for stud welding, or under an equivalent approved qualification test. Perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, perform an immediate retest of two test welds until each test weld passes. Failure in the immediate retest will require the welder be retested after further practice or training, performing a complete set of test welds.

Submit manufacturer's catalog data for Welding Equipment and Welding Rods and Accessories.

1.4.4 Regulatory Requirements

1.4.4.1 Fire Safety

Test roof deck as a part of a roof deck construction assembly of the type used for this project, listing as fire classified in the UL Fire Resistance, or listing as Class I construction in the FM APP GUIDE, and so labeled.

1.4.4.2 Wind Storm Resistance

Provide roof construction assembly capable of withstanding a nominal uplift pressure of 300 pounds per square foot when tested in accordance with the uplift pressure test described in the FM DS 1-28R or as described in UL 580 and in general compliance with UFC 3-301-01.

1.4.5 Fabrication Drawings

Show type and location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, cant strips, ridge and valley plates, metal closure strips, size and location of holes to be cut and reinforcement to be provided, the manufacturer's erection instructions and other pertinent details.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver deck units to the site in a dry and undamaged condition. Store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage material or overload decking during construction. The maximum uniform distributed storage load must not exceed the design live load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Repair deck finish using touch-up paint. Replace damaged material.

1.6 DESIGN REQUIREMENTS FOR ROOF DECKS

1.6.1 Properties of Sections

Properties of metal roof deck sections must comply with engineering design width as limited by the provisions of AISI D100.

1.6.2 Allowable Loads

Indicate total uniform dead and live load for detailing purposes.

PART 2 PRODUCTS

2.1 DECK UNITS

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

Provide products with an average recycled content of steel products so postconsumer recycled content plus one half of preconsumer recycled content not less than 25 percent.

2.1.1 Roof Deck

Conform to ASTM A792/A792M or ASTM A1008/A1008M for deck used in conjunction with insulation and built-up roofing. Fabricate roof deck units of the steel design thickness required by the design drawings and zinc-coated in conformance with ASTM A653/A653M, Z275 G90 coating class or aluminum-zinc coated in accordance with ASTM A792/A792M Coating Designation AZM165 AZ55.

2.1.2 Composite Deck

Conform to ASTM A653/A653M or ASTM A1008/A1008M for composite deck assembly. Fabricate deck used as the tension reinforcing in composite deck of 0.0295 inch design thickness or thicker steel with integrally

embossed or raised pattern ribs. The steel design thickness required by the design drawings. Zinc-coat in conformance with ASTM A653/A653M, G90 coating class.

2.1.3 Length of Deck Units

Provide deck units of sufficient length to span three or more spacings where possible.

2.1.4 Touch-Up Paint

Provide a high zinc-dust content paint for regalvanizing welds in galvanized steel conforming to ASTM A780/A780M.

Provide touch-up paint for shop-painted units of the same type used for the shop painting, and touch-up paint for zinc-coated units of an approved galvanizing repair paint with a high-zinc dust content. Touch-up welds with paint conforming to SSPC Paint 20 in accordance with ASTM A780/A780M. Maintain finish of deck units and accessories by using touch-up paint whenever necessary to prevent the formation of rust.

2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full size units. Provide factory cut plates of predetermined size where possible.

2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.0295 inch thick to close open ends at exposed edges of floors, parapets, end walls, eaves, and openings through deck.

2.2.3 Partition Closures

Provide closures for closing voids above interior walls and partitions that are perpendicular to the direction of the configurations. Provide rubber, plastic, or sheet steel closures above typical partitions, unless noted otherwise on the drawings.

2.2.4 Flexible Closure Strips for Roof Decks

Provide strips made of vulcanized, closed-cell, synthetic rubber material specified and premolded to the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

Conforming to ASTM D1056, Grade 2A1, with the following additional properties:

Brittleness temperature of minus 40 degrees F when tested in accordance with ASTM D746.

Flammability resistance with a flame spread rating of less than 25

when tested in accordance with ASTM E84.

Resistance to ozone must be "no cracks" after exposure of a sample kept under a surface tensile strain of 25 percent to an ozone concentration of 100 parts per million of air by volume in air for 100 hours at 104 degrees F and tested in accordance with ASTM D1149.

Provide a elastomeric type adhesive as recommended by the manufacturer of the flexible closure strips.

2.2.5 Closure Plates for Composite Deck

Support and retain concrete at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Provide metal closures for all openings in composite steel deck 1/4 inch and over.

2.2.6 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.2.7 Cover Plates

Sheet metal to close panel edge and end conditions, and where panels change direction or butt. Polyethylene-coated, self-adhesive, 2 inch wide joint tape may be provided in lieu of cover plates on flat-surfaced decking butt joints.

Fabricate cover plates for abutting floor deck units from the specified structural-quality steel sheets not less than nominal 18 gage thick before galvanizing. Provide 6 inch wide cover plates and form to match the contour of the floor deck units.

2.2.8 Column Closures

Sheet metal, minimum 0.0358 inch thick or metal rib lath.

2.2.9 Shear Connectors

Provide shear connectors in accordance with AWS D1.1/D1.1M headed stud Type B. Submit stud manufacture's certification that the studs delivered conform to the material requirements. Submit stud manufacture's test reports for the last completed in-plant quality control mechanical tests.

2.2.10 Cant Strips for Roof Decks

Fabricate cant strips from the specified commercial-quality steel sheets not less than nominal 0.0358 inch thick before galvanizing. Bend strips to form a 45-degree cant not less than 5 inch wide, with top and bottom flanges a minimum 3 inch wide. Length of strips 10 feet.

2.2.11 Ridge and Valley Plates for Roof Decks

Fabricate plates from the specified structural-quality steel sheets, not less than nominal 0.0358 inch thick before galvanizing. Provide plates of minimum 4-1/2 inch wide and bent to provide tight fitting closures at

ridges and valleys. Provide a minimum length of ridge and valley plates of 10 feet.

2.2.12 Metal Closure Strips for Roof Decks

Fabricate strips from the specified commercial-quality steel sheets not less than nominal 0.0358 inch thick before galvanizing. Provide strips from the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

2.2.13 Galvanized Steel Angles for Roof Decks

Provide hot-rolled carbon steel angles conforming to ASTM A36/A36M, and hot-dip galvanized in accordance with ASTM A123/A123M.

2.2.14 Mechanical Fasteners

Provide mechanical fasteners, such as powder actuated fasteners, pneumatically driven fasteners or self-drilling screws, for anchoring the deck to structural supports and adjoining units as indicated that are designed to meet the loads indicated.

2.2.15 Miscellaneous Accessories

Furnish the manufacturer's standard accessories to complete the deck installation. Furnish metal accessories of the same material as the deck and with the minimum design thickness as follows: saddles, 0.0474 inch welding washers, 0.0598 inch other metal accessories, 0.0358 inch unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

3.2 INSTALLATION

Install steel deck units in accordance with 29 CFR 1926, Subpart R - Steel Erection, ANSI/SDI QA/QC, ANSI/SDI C, ANSI/SDI RD, SDI DDM04 and approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports before permanently securing in place. Damaged deck and accessories including material which is permanently stained or contaminated, deformed, or with burned holes shall not be installed. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the Contracting Officer and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. Lap 2 inch deck ends. Do not use unanchored deck units as a work or storage platform. Do not fill unanchored deck with concrete. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated. Distribute loads by appropriate means to prevent damage.

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding with normal 5/8 inch diameter puddle welds, fastened with screws, powder-actuated fasteners, or pneumatically driven fasteners as indicated on the design drawings and in accordance with manufacturer's recommended procedure and ANSI/SDI C, ANSI/SDI NC or ANSI/SDI RD. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding or fastening. Attachment of adjacent deck units by button-punching is prohibited.

3.2.1.1 Welding

Perform welding in accordance with AWS D1.3/D1.3M using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in AWS D1.3/D1.3M make welds. Immediately recertify, or replace qualified welders, that are producing unsatisfactory welding. Conform to the recommendations of the Steel Deck Institute and the steel deck manufacturer for location, size, and spacing of fastening. Do not use welding washers at the connections of the deck to supports. Do not use welding washers at sidelaps. Holes and similar defects will not be acceptable. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDM04. Attach shear connectors as shown and welded as per AWS D1.1/D1.1M through the steel deck to the steel member. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of coated finish with zinc-dust paint conforming to ASTM A780/A780M finish with the manufacturer's standard touch-up paint.

3.2.1.2 Mechanical Fastening

Anchor deck to structural supports and adjoining units with mechanical fasteners. Drive the powder-actuated fasteners with a low-velocity piston tool by an operator authorized by the manufacturer of the powder-actuated tool.

3.2.1.3 Sidelap Fastening

Lock sidelaps between adjacent floor deck units together by welding or screws as indicated.

3.2.2 Openings

Cut or drill all holes and openings required and be coordinated with the drawings, specifications, and other trades. Frame and reinforce openings through the deck in conformance with SDI DDP. Reinforce holes and openings

6 to 12 inch across by 0.0474 inch thick steel sheet at least 12 inch wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 6 inch on center. Reinforce holes and openings larger than 12 inch by steel channels or angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Install steel channels or angles perpendicular to the deck ribs and fasten to the channels or angles perpendicular to the steel joists. Deck manufacturer shall approve holes or openings larger than 6 inch in diameter prior to drilling or cutting. Openings must not interfere with seismic members such as chords and drag struts.

3.2.3 Deck Damage

SDI MOC3, for repair of deck damage.

3.2.4 Touch-Up Paint

3.2.4.1 Roof Deck

After roof decking installation, wire brush, clean, and touchup paint the scarred areas on top and bottom surfaces of metal roof decking. The scarred areas include welds, weld scars, bruises, and rust spots. Touchup galvanized surfaces with galvanizing repair paint. Touchup painted surfaces with repair paint of painted surfaces.

3.2.4.2 Floor Deck

For floor decking installation, wire brush, clean, and touchup paint the scarred areas on the top and bottom surfaces of the metal floor decking and on the surface of supporting steel members. Include welds, weld scars, bruises, and rust spots for scarred areas. Touched up the galvanized surfaces with galvanizing repair paint. Touch up the painted surfaces with paint for the repair of painted surfaces.

3.2.5 Accessory Installation

3.2.5.1 Adjusting Plates

Provide in locations too narrow to accommodate full-size deck units and install as shown on shop drawings.

3.2.5.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

3.2.5.3 Closures Above Partitions

Provide for closing voids between cells over partitions that are perpendicular to direction of cells. Provide a one-piece closure strip for partitions 4 inch nominal or less in thickness and two-piece closure strips for wider partitions. Provide sheet metal closures above fire-rated partitions at both sides of partition with space between filled with fiberglass insulation. Provide flexible rubber closures above acoustic-rated partitions at both sides of partition with space between filled with blanket insulation.

3.2.5.4 Column Closures

Provide for spaces between floor decking and columns which penetrate the deck. Field cut closure plate to fit column in the field and tack weld to decking and columns.

3.2.6 Concrete Work

Prior to placement of concrete, inspect installed decking to ensure that there has been no permanent deflection or other damage to decking. Replace decking which has been damaged or permanently deflected as approved by the Contracting Officer. Place concrete on metal deck in accordance with Construction Practice of ANSI/SDI C.

3.3 CANT STRIPS FOR ROOF DECKS

Provide strips to be fusion welded to surface of roof decking, secured to wood nailers by galvanized screws or to steel framing by galvanized self-tapping screws or welds. Do not exceed spacing of welds and fasteners of 12 inch. Lap end joints a minimum 3 inch and secure with galvanized sheet metal screws spaced a maximum 4 inch on center.

3.4 RIDGE AND VALLEY PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 3 inch. For valley plates, provide endlaps to be in the direction of water flow.

3.5 CLOSURE STRIPS FOR ROOF DECKS

Provide closure strips at open, uncovered ends and edges of the roof decking and in voids between roof decking and top of walls and partitions where indicated. Install closure strips in position in a manner to provide a weathertight installation.

3.6 ROOF INSULATION SUPPORT FOR ROOF DECKS

Provide metal closure strips for support of roof insulation where rib openings in top surface of metal roof decking occur adjacent to edges and openings. Weld metal closure strips in position.

3.7 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

3.8 FIELD QUALITY CONTROL

3.8.1 Headed Stud Inspection

In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

- a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
- b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.8.2 Deck Weld Inspection

Visual inspect welds in accordance with AWS D1.3/D1.3M.

3.8.3 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges should not exceed manufacturing and

construction tolerances of supporting members. When gap is more than the allowable, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

-- End of Section --

SECTION 05 40 00

COLD-FORMED METAL FRAMING

05/15, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318 (2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100 (2012) North American Specification for the Design of Cold-Formed Steel Structural Members

AISI S110 (2007; Suppl 1; Reaffirmed 2012) Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames

AISI S200 (2007) North American Standard for Cold-Formed Steel Framing - General Provision

AISI S201 (2007) North American Standard for Cold-Formed Steel Framing - Product Data

AISI S202 (2011) Code of Standard Practice for Cold-formed Steel Structural Framing

AISI S211 (2007) North American Standard for Cold-Formed Steel Framing - Wall Stud Design

AISI S212 (2007) North American Standard for Cold-Formed Steel Framing - Header Design

AISI S213 (2007; Suppl 1 2009) North American Standard for Cold-Formed Steel Framing - Lateral Design

AISI S214 (2012) North American Standard for Cold-Formed Steel Framing - Truss Design

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding

Code - Steel

AWS D1.3/D1.3M (2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153/A153M (2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A307 (2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

ASTM A370 (2020) Standard Test Methods and Definitions for Mechanical Testing of Steel Products

ASTM A653/A653M (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A1003/A1003M (2015) Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members

ASTM C955 (2017) Standard Specification for Cold-Formed Steel Structural Framing Members

ASTM C1007 (2020) Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories

ASTM C1513 (2018) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections

ASTM E119 (2020) Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM E329 (2021) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

ASTM E488/E488M (2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

ASTM F1554 (2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield

Strength

ASTM F1941 (2010) Standard Specification for
Electrodeposited Coatings on Threaded
Fasteners (Unified Inch Screw Threads
(UN/UNR))

ASTM F2329/F2329M (2015) Standard Specification for Zinc
Coating, Hot-Dip, Requirements for
Application to Carbon and Alloy Steel
Bolts, Screws, Washers, Nuts, and Special
Threaded Fasteners

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2019) Structural Engineering

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Framing Components; G

SD-03 Product Data

Steel Studs, Joists, Tracks, Bracing, Bridging and Accessories

SD-05 Design Data

Metal Framing Calculations; G

SD-07 Certificates

Load-Bearing Cold-Formed Metal Framing

Welds

Recycled Content; S

Regional Material; S

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Sourcing of Raw Materials

Provide recycled content certifications of steel products.

Provide regional material certifications of steel products.

1.4 DELIVERY, STORAGE, AND HANDLING

Steel framing and related accessories shall be stored and handled in accordance with the AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".

1.5 LOAD-BEARING COLD-FORMED METAL FRAMING

Include top and bottom tracks, bracing, fastenings, and other accessories necessary for complete installation. Framing members shall have the structural properties indicated. Where physical structural properties are not indicated, they shall be as necessary to withstand all imposed loads. Design framing in accordance with AISI S100. Non-load-bearing metal framing, furring, and ceiling suspension systems are specified in Section 09 22 00 SUPPORTS FOR PLASTER AND GYPSUM BOARD. Metal suspension systems for acoustical ceilings are specified in Section 09 51 00 ACOUSTICAL CEILINGS.

Submit mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A370.

1.6 MAXIMUM DEFLECTION

Deflections of structural members shall not exceed the more restrictive of the limitations of ICC IBC and UFC 3-301-01.

1.7 QUALITY ASSURANCE

- a. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a registered professional engineer.
- b. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 for testing indicated.
- c. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- d. Welding Qualifications: Qualify procedures and personnel according to the following:
 - (1) AWS D1.1/D1.1M, "Structural Welding Code - Steel".
 - (2) AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel".
- e. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E119 by, and displaying a classification label from, a testing and inspecting agency acceptable to authorities

having jurisdiction.

f. AISI Specifications and Standards: Comply with:

- (1) AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members".
- (2) AISI S110, "Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames".
- (3) AISI S200, "North American Standard for Cold-Formed Steel Framing - General Provision".
- (4) AISI S201, "North American Standard for Cold-Formed Steel Framing - Product Data".
- (5) AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".
- (6) AISI S211, "North American Standard for Cold-Formed Steel Framing - Wall Stud Design".
- (7) AISI S212, "North American Standard for Cold-Formed Steel Framing - Header Design".
- (8) AISI S213, "North American Standard for Cold-Formed Steel Framing - Lateral Design".
- (9) AISI S214, "North American Standard for Cold-Formed Steel Framing - Truss Design".

1.7.1 Drawing Requirements

Submit framing components to show sizes, thicknesses, layout, material designations, methods of installation, and accessories including the following:

- a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.
- b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.
- c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

Sign and seal fabrication drawings by a registered professional engineer.

1.7.2 Design Data Required

Submit metal framing calculations with design criteria and structural loading to verify sizes, thickness, and spacing of members and connections signed and sealed by a registered professional engineer. Show methods and practices used in installation.

PART 2 PRODUCTS

2.1 STEEL STUDS, JOISTS, TRACKS, BRACING, BRIDGING AND ACCESSORIES

Framing components shall comply with ASTM C955 and the following.

- a. Provide products with an average recycled content of steel products so postconsumer recycled content plus one half of preconsumer recycled content not less than 25 percent.
- b. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - (1) Grade: As required by structural performance.
 - (2) Coating: G90 (Z275).
- c. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - (1) Minimum Base-Metal Thickness: as required by structural performance.
 - (2) Flange Width: as required by structural performance.
- d. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
 - (1) Minimum Base-Metal Thickness: Matching steel studs.
 - (2) Flange Width: as required by structural performance.

2.1.1 Studs and Joists of 54 mils (0.054 Inch) and Heavier

Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS Grade 50, G90.

2.1.2 Studs and Joists of 43 mils (0.043 Inch) and Lighter

Studs and Joists of 43 mils (0.043 Inch) and Lighter, Track, and Accessories (All thicknesses): Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS, Grade 33 33,000 psi G60.

2.1.3 Sizes, Thickness, Section Modulus, and Other Structural Properties

Size and thickness as required.

2.2 MARKINGS

Studs and track shall have product markings stamped on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 4 feet on center and shall be legible and easily read. The product marking shall include the following:

- a. An ICC number.
- b. Manufacturer's identification.
- c. Minimum delivered uncoated steel thickness.

- d. Protective coating designator.
- e. Minimum yield strength.

2.3 CONNECTIONS

2.3.1 Steel-To-Concrete Connections

- a. Anchor Rods: ASTM F1554, Grade 55; galvanized per ASTM A153/A153M.
- b. Post-Installed Concrete Anchors: Adhesive or expansion anchors fabricated from corrosion-resistant materials with allowable load capacities in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.
- c. Power-Actuated Fasteners: Fabricated from corrosion-resistant materials with allowable load capacities in accordance with ICC-ES AC 70 greater than or equal to the design load as determined by testing per ASTM E1190 conducted by a qualified testing agency.

2.3.2 Steel-To-Steel Connections

- a. Screws: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel screws of the type and size indicated. Provide low-profile head beneath sheathing and manufacturer's standard elsewhere. Electroplated to a minimum of 5 micron zinc coating per ASTM F1941 or hot-dipped galvanized per ASTM A123/A123M or ASTM A153/A153M.
- b. Bolts: ASTM A307 coated by hot-dip process per ASTM F2329/F2329M or zinc-coated by mechanical-deposition process per ASTM B695, Class 55.
- c. Welding Electrodes: Comply with AWS standards.

2.4 PLASTIC GROMMETS

Supply plastic grommets for stud webs as recommended by stud manufacturer, to protect electrical wires and plumbing piping. Prevent metal-to-metal contact between wiring/piping and studs.

2.5 SEALER GASKET

Closed-cell neoprene foam, 1/4-inch thick, selected from manufacturer's standard widths to match width of bottom track on concrete slab or foundation.

PART 3 EXECUTION

3.1 FASTENING

Fasten framing members together by welding or by using self-drilling, self-tapping screws. Electrodes and screw connections shall be as required and indicated in the design calculations.

3.1.1 Welds

All welding shall be performed in accordance with AWS D1.3/D1.3M, as modified by AISI S100. All welders, welding operations, and welding

procedures shall be qualified according to AWS D1.3/D1.3M. Submit certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3/D1.3M. All welds shall be cleaned and coated with rust inhibitive galvanizing paint. Do not field weld materials lighter than 43 mils.

3.1.2 Screws

Screws shall be of the self-drilling self-tapping type, size, and location as required. Screw penetration through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI S100. Screws covered by sheathing materials shall have low profile heads.

3.1.3 Anchors

Anchors shall be of the type, size, and location as required.

3.1.4 Powder-Actuated Fasteners

Powder-actuated fasteners shall be of the type, size, and location as required.

3.2 INSTALLATION

Install cold-formed framing in accordance with ASTM C1007 and AISI S200.

Install cold-formed steel framing according to AISI S202 and to manufacturer's written instructions unless more stringent requirements are indicated.

3.2.1 Tracks

Provide accurately aligned runners at top and bottom of studs. Install sealer gasket under bottom of track on concrete slab or foundation. Anchor tracks as indicated in design calculations. Butt weld joints in tracks or splice with stud inserts. Fasteners shall be at least 3 inches from the edge of concrete slabs.

3.2.2 Studs

Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors and other openings 2 feet wide or larger. Provide jack studs over openings, as necessary, to maintain indicated stud spacing. Provide tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by welding or screwing both flanges to the tracks. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall. In curtain wall construction, provide for vertical movement where studs connect to the structural frame. Provide horizontal bracing in accordance with the design calculations and AISI S100. Bracing shall be not less than the following:

<u>LOAD</u>	<u>HEIGHT</u>	<u>BRACING</u>
Wind load only	Up to 10 feet	One row at mid-height
	Over 10 feet	Rows 5'-0" o.c. maximum
Axial load	Up to 10 feet	Two rows at 1/3 points
	Over 10 feet	Rows 3'-4" o.c. maximum

3.2.3 Erection Tolerances

- a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:
 - (1) Layout of walls and partitions: 1/4 inch from intended position;
 - (2) Plates and runners: 1/4 inch in 8 feet from a straight line;
 - (3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and
 - (4) Face of framing members: 1/4 inch in 8 feet from a true plane.
- b. Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:
 - (1) Layout of walls and partitions: 1/4 inch from intended position;
 - (2) Plates and runners: 1/8 inch in 8 feet from a straight line;
 - (3) Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and
 - (4) Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

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SECTION 05 50 13

FACILITIES MISCELLANEOUS METAL FABRICATIONS

05/17, CHG 1: 08/18

PART 1 GENERAL

1.1 INTRODUCTION

This section applies to miscellaneous metal fabrications for facilities. Refer to SECTION 05 50 16 WATERFRONT MISCELLANEOUS METAL FABRICATIONS for waterfront items.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 621-02 (2002) Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates

AAMA 2605 (2020) Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303 (2016) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M (2003; R 2021) Standard Specification for Gray Iron Castings

ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153/A153M (2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A240/A240M	(2020a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A480/A480M	(2020a) Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B26/B26M	(2018; E 2018) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B108/B108M	(2019) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(2016) Primer, Alkyd, Anti-Corrosive for Metal
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SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(2018) Power Tool Cleaning
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SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety -- Safety and Health
Requirements Manual

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bollards; G

Roof Hatches, Installation Drawings; G

Including fall protection items.

Canopies; G

Sunshades; G

Shelf w/ Hanging Rod; G

Wire Mesh Screen; G

Rooftop Mechanical Screenwall; G

Dock Bumper; G

Downspout Boot; G

SD-03 Product Data

Roof Hatches; G

Each Downspout Boot Type; G

Canopies; G

Sunshades; G

Rooftop Mechanical Screenwall; G

Dock Bumper; G

Downspout Boot; G

SD-04 Samples

Canopies, color chart and chips; G

Sunshades, color chart and chips; G

Rooftop Mechanical Screenwall; G

Submit manufacturer's color charts and chips, approximately 4 by 4 inches, showing full range of colors, textures and patterns available with factory applied finishes.

SD-05 Design Data

Canopy Calculations; G

Sunshade Calculations; G

Rooftop Mechanical Screenwall Calculations; G

SD-07 Certificates

Recycled Content; S

Regional Material; S

Certificates of Compliance

Certified Mill Test Reports for Chemistry and Mechanical Properties

1.3.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1.1 M&R Sourcing of Raw Materials

Provide recycled content certifications of applicable materials.

Provide regional material certifications of applicable materials.

1.4 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.5 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

1.6 MISCELLANEOUS REQUIREMENTS

1.6.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

1.6.2 Installation Drawings

Submit templates, erection, and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation in relation to the building construction.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content. Provide certificates of compliance for recycled content.

2.2 MATERIALS

Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals). Coordinate color and finish with the material to which fastenings are applied. Submit the manufacturer's certified mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied materials.

2.2.1 Stainless Steel Plate and Shapes

ASTM A240/A240M, ASTM A276/A276M, and ASTM A480/A480M, as applicable. Alloy 316L.

2.2.2 Aluminum Alloy Products

Provide in accordance with ASTM B209M, ASTM B209 for sheet plate, ASTM B221M, ASTM B221M, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.3 FABRICATION FINISHES

2.3.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Provide galvanizing in accordance with ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, Z275 G90.

2.3.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.3.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint in accordance with ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat, with a torch, surfaces to which stick or paste material will be applied. Heat to a temperature sufficient to melt the metals in the stick or paste. Spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.3.4 Shop Cleaning and Painting

2.3.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with

SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete must be free of dirt and grease prior to embed. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints. Shop coat these surfaces with rust prevention.

2.3.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.3.6 Aluminum Surfaces

2.3.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.3.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AAMA 621-02. Unless otherwise specified, provide all other aluminum items with a custom color coating finish. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations. Provide in accordance with AAMA 621-02.

2.4 BOLLARDS

Provide exterior and interior bollards where indicated on drawings. Bollards to be fashioned from steel pipe per ASTM A53/A53M.

Exterior bollards to use galvanized extra strong Schedule 80 steel pipe. Anchor posts into concrete as indicated in drawings. Finish as indicated in drawings.

Interior bollards to use Schedule 40 steel pipe, capped and welded to base plate. Finish to be powder coated safety yellow.

2.5 DOWNSPOUT BOOT

Provide cast iron downspout boot with receiving bells sized to fit downspouts. Boot to connect to stormwater underground piping. Boot material to comply with ASTM A48/A48M Class 30 gray iron. Cleanout access to be located on the side of the boot with a cast iron cover and neoprene gasket. Cover to be fastened over cleanout window on main body with S.S. tamper proof screws. Install boots with S.S. expansion anchors where integral lug slots meet the building wall. Downspout boot to have no boxed corners, weld seams or choke points to increase the risk of clogging. Finish to be powder coated to meet AAMA 621-02. Color to match associated downspout.

2.6 MISCELLANEOUS PLATES AND SHAPES

Provide items that do not form a part of the structural steel framework, such as embedded angles, miscellaneous mountings and frames.

Provide angles, plates, and other shapes for embedment as indicated. Galvanize embedded items exposed to the elements in accordance with ASTM A123/A123M.

2.7 ROOF HATCHES

Provide aluminum sheets not less than 14 gauge with 3 inch beaded flange, welded and ground at corners. Provide a minimum clear opening of 30 by 36 inches. Insulate cover and curb with one inch thick rigid fiberboard insulation, covered and protected by aluminum sheet of not less than 26 gage. Provide with 12 inches high curb, formed with 3 inch mounting flanges with holes for securing to the roof deck.

Provide insulated cover and curb with mounting flanges for securing to roof deck. Provide curbs with an integral metal cap flashing of the same gage and metal as the curb, full welded and ground at corners for weather tightness.

Provide hatch completely assembled with pintle hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles on inside and outside, and neoprene draft seal. Provide fasteners for padlocking on the inside. Equip the cover with an automatic hold-open arm complete with grip handle to permit one-hand release. Cover action shall be smooth through its entire range with an operating pressure of approximately 30 pounds.

2.7.1 Roof Hatch Fall Protection

Provide OSHA compliant safety railing around hatch with self-closing swinging gate. System to be provided by roof hatch manufacturer and mounted to roof hatch curb. Railing to extend 42 inches above the landing platform to provide fall protection at the roof hatch. Gate to have spring loaded hinges. Finish/color to be powder coated yellow.

Provide OSHA compliant spring assisted telescoping metal safety post designed to attach to the top two rungs of a fixed vertical ladder. Post to extend 42 inches above the landing platform to aid safe ladder access through a roof hatch. Finish/color to be powder coated yellow.

2.7.2 Roof Hatch Access Ladder

See specification Section 05 51 33, METAL LADDERS.

2.8 CANOPIES AND SUNSHADES

Canopies and sunshades to be provided by the same manufacturer.

To be constructed of extruded 6063-T5 or T52 aluminum with a wall thickness not less than 0.081. All fasteners shall be passivated stainless steel with washers for corrosion resistance.

Design systems to withstand standard wind pressure, snow load and drifting load as indicated on drawings and provide canopy calculations and sunshade calculations.

System to have factory applied organic powder coated finish with 70% PVDF to meet or exceed AAMA 2605. Color(s) as indicated on drawings.

Manufacturer to warrant canopy/sunshade components to be free from defects in materials and workmanship for 1 year from date of shipment.
Manufacturer to warrant the factory applied finish be free from defects in materials and workmanship for 5 years from date of shipment. Installer to warrant installation and workmanship for 1 year from date of substantial completion of canopy/sunshade and components.

2.8.1 Canopies

Provide building supported, pre-engineered metal canopy, including fascia channels, decking, tension rods and attachment hardware. Canopies to be of type and size as indicated on drawings.

- a. Framing: 8 inch x 0.125 inch 'J' channel.
- b. Decking: 3 inch x 6 inch x 0.090 inch interlocking extruded flat soffit decking.
- c. Hanger rod supports: 3/4 inch rod with fully sealed escutcheon plate.

Drainage to be designed to be concealed in profile. Provide drainage scuppers as recommended by manuf - no less than a single scupper at outside corner of canopy. At 25 foot wide canopy provide no less than scupper at either outside corners of canopy. Drainage scupper locations to be finalized in shop drawings.

2.8.2 Sunshades

Provide building supported cantilevered, pre-engineered metal sunshade, including fascia, perimeter, outriggers, intermediate framing members, louvers and attachment hardware. Louvers to be of type, size, spacing and orientation as indicated on drawings.

- a. Framing: 6 inch x 2 inch tube, continuous. Where extruded length possibilities are exceeded provide minimal breaks in framing at outriggers located symmetrically along the length of the sunshade.
- b. Outriggers: 6 inch x 2 inch tube. Located as required per performance requirements and indicated on drawings.
- c. Louvers: 6 inch x 1 inch tube, spaced and angled as shown in drawings.

2.9 DIVE LOCKER STORAGE

Steel finishes to be powder coated, color black. Use corrosion-resistant steel fittings and fasteners.

2.9.1 Shelf w/ Hanging Rod

Provide a 24 inch deep wire mesh shelf and stainless steel hanging rod. Shelf to have a heavy-duty steel tube frame and high-strength 1.5 inch by 1.5 inch by 0.135 inch thick steel wire. Brackets to be heavy-duty tubular angle type with gusseted support wire. Brackets to hold stainless steel hanging rod. Capacity of shelf to be 25 pounds per linear foot. Capacity of hanging rod to be 50 pounds per linear foot.

2.9.2 Wire Mesh Screen

Provide 24 inch deep by 58 inch tall wall hung wire mesh screen. Frame to

be 1 inch steel channel. Mesh to be 1.5 inch by 1.5 inch by 0.135 thick. Secure wall hung screen with 42 inches long, continuous flanges. Design screen system to withstand bending stress, shear stress, shear force and tensile force induced by 200 lbf.

2.10 ROOFTOP MECHANICAL SCREENWALL

Provide roof screen system using 45 degree inverted-blade profile louvers at 6 inches on center or as required to provide vision proofing to a 90 degree angle. Louvers shall be continuous, not interrupted by frame flanges or mullions. Corner of screenwall to be mitered. Mount to vertical trees and concealed snap-in retainer clips provided by roof screen manufacturer.

Design screenwall system to meet wind pressures as indicated on structural drawings including system connection to structural steel frame and provide rooftop mechanical screenwall calculations. Isolators such as Teflon and neoprene should be placed between alum and other materials to prevent direct contact. Screenwall system to include structural steel horizontal hat channels/girts as required to meet wind pressures.

Louver blade to be 0.100 inch thick extruded aluminum, ASTM B221, Alloy 6063-T6. Finish to meet AAMA 2605. Color as indicated on drawings.

2.11 DOCK BUMPER

Provide black rubber dock bumper consisting of recycled fabric reinforced rubber pads woven on steel rods. Size 10 inches high x 12 inches width x 4.5 inches depth. Mount to dock concrete slab with 3 inch galvanized steel angles and anchor bolts per manufacturer details. Coordinate final location of bumpers with contracting officer based on anticipated truck types at loading dock.

2.12 DUMPSTER ENCLOSURE GATES

Fabricate swing gates for dumpster enclosure utilizing an aluminum tube frame with an aluminum louvered interior panel. Louvered panel shall be sight proof. Provide galvanized tube support posts, hinges and lift-rod gate locking mechanisms. Provide hard rubber travel wheel for each leaf. All gate frames, panels and hardware shall be prefinished to meet AAMA 2605.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated in accordance with manufacturer's instructions. Verify all field dimensions prior to fabrication. Include materials and parts necessary to complete each assembly, whether indicated or not. Misalignment and mis-sizing of holes for fasteners is cause for rejection. Conceal fastenings where practicable. Joints exposed to weather must be watertight.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is true and accurate in shape, size, and profile. Make angles and lines continuous and straight. Make curves consistent, smooth and unfaceted. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections. Unless otherwise indicated and approved,

provide a smooth finish on exposed surfaces. Provide coped and mitered corner joints aligned flush and without gaps.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage as necessary, whether indicated or not, for fastening miscellaneous metal items securely in place. Include slotted inserts, headed shear studs, machine and carriage bolts for steel, through bolts, lag bolts, and screws for wood. Do not use wood plugs. Provide non-ferrous attachments for non-ferrous metal. Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals), that generally match in color and finish the surfaces to which they are applied. Conceal fastenings where practicable. Provide all fasteners flush with the surfaces they fasten, unless indicated otherwise.

3.4 BUILT-IN WORK

Where necessary and not otherwise indicated, form built-in metal work for anchorage with concrete or masonry. Provide built-in metal work in ample time for securing in place as the work progresses.

3.5 WELDING

Perform welding, welding inspection, and corrective welding in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation. Provide welded headed shear studs in accordance with AWS D1.1/D1.1M, Clause 7, except as otherwise specified. Provide in accordance with the safety requirements of EM 385-1-1.

3.6 DISSIMILAR METALS

Where dissimilar metals are in contact, protect surfaces with a coating in accordance with MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect in accordance with ASTM D1187/D1187M, asphalt-base emulsion. Clean surfaces with metal shavings from installation at the end of each work day.

3.7 PREPARATION

3.7.1 Material Coatings and Surfaces

Remove rust preventive coating just prior to field erection, using a remover approved by the metal manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

3.7.2 Environmental Conditions

Do not clean or paint surfaces when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than minus 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer. Metal surfaces to be painted must be dry for a minimum of 48 hours prior to the application of primer or paint.

3.8 INSTALLATION OF BOLLARDS

Set exterior bollards vertically in concrete piers. Fill hollow cores

with concrete having a compressive strength of 3000 psi. Interior bollards to be surface mounted as indicated in drawings and per manufacturer's instructions.

3.9 INSTALLATION OF DOWNSPOUT TERMINATIONS

Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

3.10 CANOPIES AND LOUVERED SUNSHADES

Field verify dimensions of supporting structure at site of installation prior to fabrication. Install components plumb and level, in proper plane, free from warp and twist. Anchor system to building components; provide adequate clearance for movement caused by thermal expansion and contraction and wind loads. Touch up all minor scratches and abrasions on finished surfaces to match original finish for all installed metal fabrications.

-- End of Section --

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SECTION 05 50 14

STRUCTURAL METAL FABRICATIONS
08/18

PART 1 GENERAL

1.1 INTRODUCTION

This section applies to the following waterfront structural steel used for:

- a. Electrical platforms built on the Pier.
- b. Welded connections related to the combination Pipe-Z bulkhead.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	(2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel
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AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B4.1	(1967; R 1994; R 2004; R 2009; R 2020) Preferred Limits and Fits for Cylindrical Parts
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AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
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AWS D1.2/D1.2M	(2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum
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AWS QC1	(2016) Specification for AWS Certification of Welding Inspectors
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ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
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ASTM A380/A380M	(2017) Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
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ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
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ASTM E165/E165M	(2018) Standard Practice for Liquid Penetrant Examination for General Industry
ASTM E709	(2021) Standard Guide for Magnetic Particle Testing

RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC)

RCSC A348	(2020) RCSC Specification for Structural Joints Using High-strength Bolts
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1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

- Detail Drawings; G
- Welding Procedures; G
- Welding Repair Plan

SD-03 Product Data

- Filler Metal

SD-06 Test Reports

- Tests, Inspections, and Verifications

SD-07 Certificates

- Welding Qualifications
- Weld Inspection Log
- Certified Welding Inspector
- Nondestructive Testing Personnel

1.4 QUALITY ASSURANCE

1.4.1 Detail Drawings

Submit detail drawings for metalwork and machine work, prior to fabrication, include within the detail drawings catalog cuts, templates, fabrication and assembly details and type, grade and class of material as appropriate. Indicate methods of protecting the work during shipping, storage, field assembly, and installation.

1.4.2 Welding Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified

under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welder or welding operator is more than 6 months old, accompany the welding operator's qualification certificate with a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 FABRICATION

2.1.1 Structural Fabrication

Material must be straight before being laid off or worked. Perform straightening, if necessary, by methods that will not impair the metal. Sharp kinks or bends are cause for rejection of the material. Material with welds will not be accepted except where welding is definitely specified, indicated or otherwise approved. Make bends using approved dies, press brakes or bending rolls. Where heating is required, take precautions to avoid overheating the metal and allow it to cool in a manner that will not impair the original properties of the metal. Proposed flame cutting of material, other than structural steel, is subject to approval and must be indicated on detail drawings. Shearing must be accurate and all portions of the work neatly finished. Make corners square and true unless otherwise shown. Fillet re-entrant cuts to a minimum radius of 3/4 inch unless otherwise approved. Provide finished members free of twists, bends and open joints. Tighten bolts, nuts and screws.

2.1.1.1 Dimensional Tolerances for Structural Work

Measure dimensions using an approved calibrated steel tape of approximately the same temperature as the material being measured. The overall dimensions of an assembled structural unit must be within the tolerances indicated on the drawings or as specified in the particular section of these specifications for the item of work. Where tolerances are not specified in other sections of these specifications or shown, an allowable variation of 1/32 inch is permissible in the overall length of component members with both ends milled; component members without milled ends must not deviate from the dimensions shown by more than 1/16 inch for members 30 feet or less in length, and by more than 1/8 inch for members over 30 feet in length.

2.1.1.2 Structural Steel Fabrication

Structural steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a surface that is smooth and free from cracks and notches is obtained. Prepare surfaces and edges in accordance with AWS D1.1/D1.1M, Prequalification of WPSs Clause. Where structural steel is not to be welded, chipping or grinding will not be required except as necessary to remove slag and sharp edges of mechanically guided or hand-guided cuts not exposed to view. Chip, grind or machine to sound metal hand-guided cuts which are to be exposed or visible.

2.1.2 Welding

2.1.2.1 Welding of Structural Steel

2.1.2.1.1 Welding Procedures for Structural Steel

Use prequalified welding procedures for structural steel as described in AWS D1.1/D1.1M, Prequalification of WPSs Clause or qualify by tests as prescribed in AWS D1.1/D1.1M, Qualification Clause. For welding procedures qualified by tests, the coupon welding and specimen testing will be witnessed and the test report document signed by the Contracting Officer. Approval of any welding procedure does not relieve the Contractor of the responsibility for producing a finished structure meeting all requirements of these specifications. The Contractor will be directed or authorized to make any changes in previously approved welding procedures that are deemed necessary or desirable by the Contracting Officer.

- a. Submit a complete schedule of welding procedures for each steel structure to be welded prior to commencing fabrication. Provide the schedule in conformance with the requirements specified in the provisions of AWS D1.1/D1.1M
- b. Provide within the schedule detailed procedure specifications and tables or diagrams showing the procedures to be used for each required joint. Include in the welding procedures filler metal, preheat, interpass temperature and stress-relief heat treatment requirements. Clearly identify each welding procedure as being prequalified or required to be qualified by tests.
- c. Show types and locations of welds designated or in the specifications to receive nondestructive testing in the welding procedures.

2.1.2.1.2 Welding Process

Perform welding of structural steel by an electric arc welding process using a method which excludes the atmosphere from the molten metal and conforms to the applicable provisions of AWS D1.1/D1.1M. Minimize residual stresses, distortion and shrinkage from welding.

2.1.2.1.3 Welding Technique

2.1.2.1.3.1 Filler Metal

Provide the electrode, electrode-flux combination and grade of filler metal conforming to the appropriate AWS specification for the base metal and welding process being used or be as shown where a specific choice of AWS specification allowables is required. Submit filler metal product data. Include the AWS designation of the electrodes to be used in the schedule of welding procedures. Use only low hydrogen electrodes for manual shielded metal-arc welding regardless of the thickness of the steel. Use a controlled temperature storage oven at the job site as prescribed by AWS D1.1/D1.1M, Fabrication Clause to maintain low moisture of low hydrogen electrodes.

2.1.2.1.3.2 Preheat and Interpass Temperature

Perform preheating as required by AWS D1.1/D1.1M, Fabrication Clause or as otherwise specified except that the temperature of the base metal must be

at least 70 degrees F. Slowly and uniformly preheat the joint area by approved means to the prescribed temperature, held at that temperature until the welding is completed and then permitted to cool slowly in still air.

2.1.2.1.4 Workmanship

Perform welding workmanship in accordance with AWS D1.1/D1.1M, Fabrication Clause and other applicable requirements of these specifications.

2.1.2.1.4.1 Preparation of Base Metal

Prior to welding inspect surfaces to be welded to ensure compliance with AWS D1.1/D1.1M, Fabrication Clause.

2.1.2.1.4.2 Temporary Welds

Make temporary welds, required for fabrication and erection, under the controlled conditions prescribed for permanent work. Make temporary welds using low-hydrogen welding electrodes and by welders qualified for permanent work as specified in these specifications. Conduct preheating for temporary welds as required by AWS D1.1/D1.1M for permanent welds except that the minimum temperature must be 120 degrees F in any case. In making temporary welds, do not strike arcs in other than weld locations. Remove each temporary weld and grind flush with adjacent surfaces after serving its purpose.

2.1.2.1.4.3 Tack Welds

Tack welds that are to be incorporated into the permanent work are to exhibit the same quality requirements as the permanent welds; clean and thoroughly fuse them with permanent welds. Perform preheating as specified above for temporary welds. Provide cascaded ends on multiple-pass tack welds. Remove defective tack welds before permanent welding.

2.1.2.2 Welding of Steel Studs

Welding of steel studs must conform to the requirements of AWS D1.1/D1.1M, Stud Welding Clause, except as otherwise specified for the procedures for welding steel studs to structural steel, including mechanical, workmanship, technique, stud application qualification, production quality control and fabrication and verification inspection procedures.

2.1.2.2.1 Production Control

Production control of stud welding must conform to the requirements of AWS D1.1/D1.1M, Stud Welding Clause, except as otherwise specified for quality control for production welding of studs. Weld studs on which pre-production testing is to be performed must be in the same general position as required on production studs (flat, vertical, overhead or sloping). If the reduction of the length of studs becomes less than normal as they are welded, stop welding immediately and do not resume until the cause has been corrected.

2.1.3 Bolted Connections

2.1.3.1 Bolted Structural Steel Connections

Provide bolts, nuts and washers of the type specified or indicated. Equip all nuts with washers except for high strength bolts. Use beveled washers where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. All bolted connections are snug tight in accordance with RCSC A348.

- a. Accurately locate bolt holes, smooth, perpendicular to the member and cylindrical.
- b. Drill or subdrill holes for regular bolts and ream in the shop and not more than 1/16 inch larger than the diameter of the bolt.
- c. Match-ream or drill holes for fitted bolts in the shop. Remove burrs resulting from reaming. Keep bolt threads entirely outside of the holes. The body diameter of bolts must have tolerances as recommended by ASME B4.1 for the class of fit specified. Place fitted bolts in reamed holes by selective assembly to provide an LN-2 fit.

2.1.4 Miscellaneous Provisions

2.1.4.1 Metallic Coatings

- a. Zinc Coatings - Apply zinc coatings in a manner and of a thickness and quality conforming to ASTM A123/A123M. Where zinc coatings are destroyed by cutting, welding or other causes regalvanize the affected areas. Regalvanize coatings 2 ounces or heavier with a suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Repair coatings less than 2 ounces in accordance with ASTM A780/A780M.

2.1.4.2 Cleaning of Corrosion-Resisting Steel

Remove oil, paint and other foreign substances from corrosion-resisting steel surfaces after fabrication. Perform cleaning by vapor degreasing or by the use of cleaners of the alkaline, emulsion or solvent type. After the surfaces have been cleaned give a final rinsing with clean water followed by a 24 hour period during which the surfaces are intermittently wet with clean water and then allowed to dry for the purpose of inspecting the clean surfaces. Visually inspect the surfaces for evidence of paint, oil, grease, welding slag, heat treatment scale, iron rust or other forms of contamination. If evidence of foreign substance is found, clean again in accordance with the applicable provisions of ASTM A380/A380M. Furnish the proposed method of treatment for approval. Visually reinspect after treatment. Use only stainless steel or nonmetallic bristle brushes to remove foreign substances. Remove any contamination occurring subsequent to the initial cleaning by one or more of the methods indicated above.

2.2 TESTS, INSPECTIONS, AND VERIFICATIONS

Perform material tests and analyses certified by an approved laboratory to demonstrate that materials are in conformity with the specifications. These tests and analyses must be performed and certified at the Contractor's expense. Perform tests, inspections, and verifications conforming to the requirements of the particular sections of these

specifications for the respective items of work unless otherwise specified or authorized. Conduct tests in the presence of the Contracting Officer if so required. Furnish specimens and samples for additional independent tests and analyses upon request by the Contracting Officer. Properly label specimens and samples and prepare for shipment. Submit certified test reports for materials with all materials delivered to the site.

2.2.1 Nondestructive Testing

When doubt exists as to the soundness of any material part, such part may be subjected to any form of nondestructive testing determined by the Contracting Officer. This may include ultrasonic, magnaflux, dye penetrant, x-ray, gamma ray or any other test that will thoroughly investigate the part in question. The cost of such investigation will be borne by the Government if the part is found to be sound and by the Contractor if the part is found to be defective. Any defects will be cause for rejection; replace and retest rejected parts at the Contractor's expense.

2.2.2 Inspection of Structural Steel Welding

Nondestructive testing of designated welds will be required. Supplemental examination of any joint or coupon cut from any location in any joint may also be required.

2.2.2.1 Visual Examination

All visual inspection will be conducted in accordance with AWS D1.1/D1.1M, by a Certified Welding Inspector. Document this inspection in the Visual Weld Inspection Log. Submit certificates indicating that certified welding inspectors meet the requirements of AWS QC1.

2.2.2.2 Nondestructive Testing

Perform as designated or described in the sections of these specifications, the nondestructive testing of shop and field welds covering the particular items of work. Record final nondestructive testing results in the Weld Inspection Log which identifies final NDT inspection of all welds requiring inspection and submit the log.

2.2.2.2.1 Testing Agency

The nondestructive testing of welds and the evaluation of tests as to the acceptability of the welds must be performed by a testing agency adequately equipped and competent to perform such services or by the Contractor using suitable equipment and qualified personnel. All personnel performing nondestructive testing shall be certified Level I or II in the method of NDT being utilized in accordance with ANSI/ASNT CP-189. Level I inspectors must have direct supervision of a Level II inspector. Submit certification for nondestructive testing personnel prior to all testing. In either case, written approval of the examination procedures is required and performance of the examination tests must be done in the presence of the Contracting Officer. The evaluation of tests are subject to the approval and all records become the property of the Government.

2.2.2.2.2 Examination Procedures

Conform to the following requirements.

2.2.2.2.2.1 Ultrasonic Testing

Examine, evaluate and report ultrasonic testing of welds in conformance to the requirements of AWS D1.1/D1.1M, Inspection Clause, for statically loaded connections. Provide ultrasonic equipment capable of making a permanent record of the test indications. Make a record of each weld tested.

2.2.2.2.2.2 Magnetic Particle Inspection

Conform magnetic particle inspection of welds to the applicable provisions of ASTM E709.

2.2.2.2.2.3 Dye Penetrant Inspection

Perform dye penetrant inspection of welds conforming to the applicable provisions of ASTM E165/E165M.

2.2.2.2.3 Welds to be Subject to Nondestructive Testing

Test 50% of CJP welds using ultrasonic testing per Table 6.2 or 6.3 of AWS D1.1/D1.1M. Randomly test 25% of all PJP and fillet welds or as indicated by magnetic particle or dye penetrant testing.

2.2.2.3 Test Coupons

The Government reserves the right to require the Contractor to remove coupons from completed work when doubt as to soundness cannot be resolved by nondestructive testing. When coupons are removed from any part of a structure, repair the members cut in a neat manner with joints of the proper type to develop the full strength of the members. Peen repaired joints as approved or directed to relieve residual stress. The expense for removing and testing coupons, repairing cut members and the nondestructive testing of repairs is borne by the Government or the Contractor in accordance with the Contract Clauses INSPECTION AND ACCEPTANCE.

2.2.2.4 Supplemental Examination

When the soundness of any weld is suspected of being deficient due to faulty welding or stresses that might occur during shipment or erection, the Government reserves the right to perform nondestructive supplemental examinations before final acceptance. The cost of such inspection will be borne by the Government.

2.2.3 Welding Repair Plan

Repair defective welds in accordance with AWS D1.1/D1.1M, Fabrication Clause. Remove defective weld metal to sound metal by use of air carbon-arc or oxygen gouging. Thoroughly clean surfaces before welding. Retest welds that have been repaired by the same methods used in the original inspection. Except for the repair of members cut to remove test coupons and found to have acceptable welds costs of repairs and retesting will be borne by the Contractor. Submit welding repair plans for steel, prior to making repairs.

PART 3 EXECUTION

3.1 INSTALLATION

Thoroughly clean all parts to be installed. Remove packing compounds, rust, dirt, grit and other foreign matter. Clean holes and grooves for lubrication. Examine enclosed chambers or passages to make sure that they are free from damaging materials. Where units or items are shipped as assemblies they will be inspected prior to installation. Disassembly, cleaning and lubrication will not be required except where necessary to place the assembly in a clean and properly lubricated condition. Do not use pipe wrenches, cold chisels or other tools likely to cause damage to the surfaces of rods, nuts or other parts used for assembling and tightening parts. Tighten bolts and screws firmly and uniformly but take care not to overstress the threads. When a half nut is used for locking a full nut place the half nut first followed by the full nut. Lubricate threads of all bolts except high strength bolts, nuts and screws with an appropriate lubricant before assembly. Coat threads of corrosion-resisting steel bolts and nuts with an approved antigalling compound. Driving and drifting bolts or keys will not be permitted.

3.1.1 Alignment and Setting

Accurately align each machinery or structural unit by the use of steel shims or other approved methods so that no binding in any moving parts or distortion of any member occurs before it is fastened in place. The alignment of all parts with respect to each other must be true within the respective tolerances required. Set true machines to the elevations shown.

3.1.2 Blocking and Wedges

Remove all blocking and wedges used during installation for the support of parts to be grouted in foundations before final grouting unless otherwise directed. Blocking and wedges left in the foundations with approval must be of steel or iron.

3.2 TESTS

3.2.1 Workmanship

Workmanship must be of the highest grade and in accordance with the best modern practices to conform with the specifications for the item of work being furnished.

3.2.2 Production Welding

Perform production welding conforming to the requirements of AWS D1.1/D1.1M or AWS D1.2/D1.2M, as applicable. Studs, on which pre-production testing is to be performed, must be welded in the same general position as required on production items (flat, vertical, overhead or sloping). Test and production stud welding will be subjected to visual examination or inspection. If the reduction of the length of studs becomes less than normal as they are welded, stop welding immediately and do not resume until the cause has been corrected.

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SECTION 05 50 16

WATERFRONT MISCELLANEOUS METAL FABRICATIONS
05/17, CHG 1: 08/18

PART 1 GENERAL

1.1 INTRODUCTION

This section applies to miscellaneous metal fabrications including but not limited to:

- a. Waterfront Structural metal fabrications and not covered in other sections.
- b. Waterfront post installed epoxy grouted anchors for general attachment to concrete.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 251 (2006; R 2020) Standard Specification for Plain and Laminated Elastomeric Bridge Bearings

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303 (2016) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)

ASME B18.2.2 (2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

ASME B18.6.2 (2020) Square Head Set Screws and Slotted Headless Set Screws (Inch Series)

ASME B18.6.3 (2013; R 2017) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

ASME B18.21.1 (2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

ASME B18.21.2M (1999; R 2014) Lock Washers (Metric Series)

ASME B18.22M (1981; R 2017) Metric Plain Washers

ASME B30.9 (2018) Slings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding
Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A29/A29M (2020) Standard Specification for General
Requirements for Steel Bars, Carbon and
Alloy, Hot-Wrought

ASTM A47/A47M (1999; R 2018; E 2018) Standard
Specification for Ferritic Malleable Iron
Castings

ASTM A53/A53M (2020) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

ASTM A123/A123M (2017) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products

ASTM A153/A153M (2016a) Standard Specification for Zinc
Coating (Hot-Dip) on Iron and Steel
Hardware

ASTM A193/A193M (2020) Standard Specification for
Alloy-Steel and Stainless Steel Bolting
Materials for High-Temperature Service and
Other Special Purpose Applications

ASTM A240/A240M (2020a) Standard Specification for
Chromium and Chromium-Nickel Stainless
Steel Plate, Sheet, and Strip for Pressure
Vessels and for General Applications

ASTM A276/A276M (2017) Standard Specification for
Stainless Steel Bars and Shapes

ASTM A307 (2021) Standard Specification for Carbon
Steel Bolts, Studs, and Threaded Rod 60
000 PSI Tensile Strength

ASTM A380/A380M (2017) Standard Practice for Cleaning,
Descaling, and Passivation of Stainless
Steel Parts, Equipment, and Systems

ASTM A467/A467M (2020) Standard Specification for Machine
Coil Chain

ASTM A480/A480M (2020a) Standard Specification for General
Requirements for Flat-Rolled Stainless and
Heat-Resisting Steel Plate, Sheet, and
Strip

ASTM A500/A500M	(2021a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A572/A572M	(2021; E 2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A992/A992M	(2020) Standard Specification for Structural Steel Shapes
ASTM A1085/A1085M	(2015) Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
ASTM C882/C882M	(2020) Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C1513	(2018) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D695	(2010) Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness

ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F436	(2011) Hardened Steel Washers
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(2016) Primer, Alkyd, Anti-Corrosive for Metal
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NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 532	(2019) Heavy Duty Metal Bar Grating Manual
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SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(2018) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual
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1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Cover Plates and Frames, Installation Drawings; G

Waterfront Gratings, Installation Drawings; G

Fender System Wale, Installation Drawings; G

Life Ring Support Frame, Installation Drawings; G

Safety Ladder, Installation Drawings; G

Utility Trench Covers, Installation Drawings; G

Utility Vaults, Installation Drawings; G

Guard Railing; G

Bollards/Pipe Guards/Guard Posts; G

SD-03 Product Data

Epoxy Anchors; G

Cover Plates and Frames; G

Waterfront Gratings; G

Recycled Content; S

SD-07 Certificates

Certificates of Compliance

Certified Mill Test Reports for Chemistry and Mechanical Properties

Lifting Slings; G

Epoxy Anchors; G

SD-06 Test Reports

Proof Test; G

1.4 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.5 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

1.6 MISCELLANEOUS REQUIREMENTS

1.6.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

1.6.2 Installation Drawings

Submit templates, erection, and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation in relation to the building construction.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content. Provide certificates of compliance for recycled content.

2.2 MATERIALS

Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals). Coordinate color and finish with the material to which fastenings are applied. Submit the manufacturer's certified mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied materials.

2.2.1 Structural Carbon Steel

- a. Wide Flanges/WT Shapes: ASTM A992/A992M or ASTM A572/A572M, Grade 50
- b. Channels: ASTM A992/A992M or ASTM A572/A572M, Grade 50.
- c. Shapes, Plates and Bars: ASTM A572/A572M, Grade 50.
- d. Angles: ASTM A572/A572M, Grade 50.

2.2.2 Stainless Steel Plate and Shapes

ASTM A240/A240M, ASTM A276/A276M, and ASTM A480/A480M, as applicable. Alloy 316L.

2.2.3 Structural Tubing

Provide in accordance with ASTM A500/A500M, Grade C or ASTM A1085/A1085M.

2.2.4 Steel Pipe

Provide in accordance with ASTM A53/A53M, Type E or S, Grade B.

2.2.5 Fittings for Steel Pipe

Provide standard malleable iron fittings in accordance with ASTM A47/A47M.

2.2.6 Gratings

- a. Provide grating in accordance with ASTM A572/A572M, Grade 50.
- b. Provide metal plank grating, non-slip requirement, steel in accordance with ASTM A653/A653M, Z275 G90.
- c. Provide metal bar type grating in accordance with NAAMM MBG 532.

2.2.7 Floor Plates, Patterned

Provide floor plate in accordance with ASTM A572/A572M, Grade 50. Provide steel plate not less than 3/8 inch thick.

2.2.8 Anchor Rods and Nuts

Provide in accordance with ASTM F1554, Grade 55 with Supplementary Requirement S1, unless otherwise indicated. Provide ASTM F1554, Grade 105 anchor rods for mooring hardware. Provide heavy hex nuts in accordance with ASTM F436. All anchor bolts, nuts, and washers must be hot dip galvanized.

2.2.8.1 Epoxy Anchors

Provide as indicated on the drawings, but at a minimum provide 3/4 in. diameter Hot Dip Galvanized (HDG) ASTM F1554, Grade 36. Adhesive anchors, exposed to tidal or submerged exposure must be 1.0 in. diameter HDG. Adhesive anchors smaller than 3/4 in. must be Type 316 stainless steel. Minimum concrete embedment of 12 diameters, unless noted otherwise. The epoxy adhesive shall meet all the following typical performance criteria when cured at 73 degrees F:

ASTM C881, Types I, II, IV and V, Grade 3, Classes B & C		
Property	Test Method	Criteria
Tesile Strength, 7 days	ASTM D638	6,310 psi
Bond Strength, 2 days	ASTM C882/C882M	1,800 psi
Bond Strength, 7 days	ASTM C882/C882M	1,800 psi
Compressive Strength	ASTM D695	12,000 psi
Compressive Modulus	ASTM D695	220,000 psi
Water Absorption	ASTM D570	0.06 percent

2.2.8.2 Bolts and Nuts

Provide in accordance with ASME B18.2.2 or ASTM A307, Grade A or C with ASTM A563 hex nut.

2.2.8.3 High Strength Bolts and Nuts

ASTM F3125/F3125M, Grade A325, Type 1 bolts with ASTM A563 heavy hex nut and ASTM F436 washers. Bolts and nuts must be purchased as a set.

2.2.8.4 Screws

Provide in accordance with ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

2.2.8.5 Washers

Provide plain washers in accordance with ASME B18.22M, ASME B18.21.1. Provide hardened washers in accordance with ASTM F436. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers in accordance with ASME B18.21.2M, ASME B18.21.1.

2.2.8.6 Welded Headed Shear Studs

Also known as Headed Anchor Studs (HAS), provide in accordance with ASTM A29/A29M, Type B.

2.3 FABRICATION FINISHES

2.3.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Provide galvanizing in accordance with ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, Z275 G90.

2.3.2 Galvanize

Anchor bolts/rods, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise. All exposed waterfront carbon steel must be galvanized with the exception of Type 316/316L Stainless Steel.

2.3.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint in accordance with ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat, with a torch, surfaces to which stick or paste material will be applied. Heat to a temperature sufficient to melt the metals in the stick or paste. Spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.3.4 Shop Cleaning and Painting

2.3.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete must be free of dirt and grease prior to embed. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints. Shop coat these surfaces with rust prevention.

2.3.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.4 FABRICATIONS

Steel fabrications must be galvanized after fabrication, unless otherwise noted. Member sizes and dimensions must be as indicated. Fabrications include, but are not limited to the following:

- a. Stainless Steel Safety Ladder
- b. Stainless Steel Utility Vaults

- c. Steel Fender System Wale
- d. Steel Life Ring Support Frame
- e. Steel Utility Trench Covers
- f. Steel Guard Railing

2.5 COVER PLATES AND FRAMES

Fabricate cover plates of indicated plate with a selected raised pattern nonslip top surface. Provide galvanized plate. Reinforce plate with stiffeners as indicated. Provide structural steel shapes and plates for frames, with bent steel bars or headed anchors welded to frame for anchoring to concrete. Miter and weld all corners. Butt joint straight runs. Allow for expansion on straight runs over 15 feet. Remove sharp edges and burrs from cover plates and exposed edges of frames. Weld all connections and grind top surface smooth. Weld bar stops every six inches. Provide 1/4 inch clearance at edges and between cover plates. Holes in pier utility trench cover plates must fit provided quad leg lifting slings.

2.6 Lifting Slings

ASME B30.9 Provide domestic 4-leg chain slings with either foundry or grab hooks, length of slings must provide at least a 45 degree sling angle. Provide one sample hook and metal hole template fabricated from a one foot square piece of 1/4 inch thick steel plate to the Contracting officer for approval prior to fabricating pier utility trench cover plates. The minimum factor of safety for lifting slings is 4.0.

2.7 PLAIN NEOPRENE ELASTOMERIC STRIPS

AASHTO M 251, Black Color, 50 +/- 5 Durometer (Shore A) Hardness per ASTM D2240, with a minimum tensile strength of 2800 psi per ASTM D412, and an minimum ultimate elongation of 400 percent per ASTM D412. Bearing strips to be placed under stiffened steel cover plates, along the pier and trestle.

2.8 WATERFRONT GRATINGS

Design steel grating in accordance with NAAMM MBG 532 for bar type gratings, or in accordance with manufacturer's charts for plank grating. Galvanize steel floor gratings. Minimum bearing bar thickness is 3/8 inch.

- a. Design waterfront gratings to support a stress live load as indicated, with maximum total deflection of L/240.
- b. In accordance with NAAMM MBG 532, band edges of gratings with bars of the same or greater thickness than the metal used for bearing bars. Weld banding in accordance with the manufacturer's standard for trim unless otherwise indicated. Design tops of bearing bars, cross or intermediate bars to be in the same plane and to match grating finish.
- c. Attach gratings to structural members with welded-on anchors, through bolts, or with drilled and tapped holes.

2.9 BOLLARDS/PIPE GUARDS/GUARD POSTS

Provide galvanized, extra strong weight (Schedule 80) steel pipe in accordance with ASTM A53/A53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 3000 psi.

2.10 MISCELLANEOUS PLATES AND SHAPES

Provide items that do not form a part of the structural steel framework, such as embedded angles, miscellaneous mountings and frames.

Provide angles, plates, and other shapes for embedment as indicated. Galvanize embedded items exposed to the elements in accordance with ASTM A123/A123M.

2.11 SAFETY CHAINS

Construct safety chains of Type 316 stainless steel, straight link type, minimum 1/4 inch diameter, with a minimum of nine links per one foot, and snap hooks on each end. Test safety chain in accordance with ASTM A467/A467M, Class CS. Provide boat type snap hooks. Provide Type 316 stainless steel, 1/2 inch bolt with 1 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated in accordance with manufacturer's instructions. Verify all field dimensions prior to fabrication. Include materials and parts necessary to complete each assembly, whether indicated or not. Miss-alignment and miss-sizing of holes for fasteners is cause for rejection. Conceal fastenings where practicable. Joints exposed to weather must be watertight.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is true and accurate in shape, size, and profile. Make angles and lines continuous and straight. Make curves consistent, smooth and unfaceted. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections. Unless otherwise indicated and approved, provide a smooth finish on exposed surfaces. Provide coped and mitered corner joints aligned flush and without gaps.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage as necessary, whether indicated or not, for fastening miscellaneous metal items securely in place. Include slotted inserts, headed shear studs, machine and carriage bolts for steel, through bolts, lag bolts, and screws for wood. Do not use wood plugs. Provide non-ferrous attachments for non-ferrous metal. Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals), that generally match in color and finish the surfaces to which they are applied. Conceal fastenings where practicable. Provide all fasteners flush with the surfaces they fasten, unless indicated otherwise.

3.3.1 Epoxy Anchors

Epoxy anchors must be installed in accordance with the manufacturer's printed installation instructions (MPIs) and as follows:

- a. Manufacturer's recommended hole diameter must be drilled using a carbide-tipped drill bit and a rotary impact hammer drill.
- b. Clean and dry hole in accordance with MPIs.
- c. Inject epoxy adhesive starting at the back of the borehole in accordance with MPIs.
- d. Verify that the anchor/rebar is dry and free of oil and other contaminants.
- e. Insert anchor/rebar into borehole to the proper embedment depth.
- f. After installing anchor the annular gap must be completely filled along the embedment depth.
- g. Secure anchor if required and allow to cure per MPIs before loading anchorage.
- h. Proof test first three epoxy, and then 10 percent of all epoxy anchors in accordance with Paragraph Titled "Proof Test".

3.3.2 Proof Test

An independent testing agency must proof test in accordance with ASTM E488/E488M the first three anchors of each type of installation and the remaining 10-percent of that anchor type to 80-percent of the rod or bar yield strength (based on gross area of the rod or threaded fastener), or less than 50-percent of the ultimate bond strength in tension of the epoxy or cementitious grout.

The proof test must be held for at least one minute with the measured deflection less than the anchor diameter divided by five (0.2 in. max deflection for a 1 in. diameter anchor).

The Contracting Officer must be notified immediately if an anchor fails to satisfy the proof test criteria for corrective action which could include abandoning the anchor and increasing the percentage of proof testing.

Contact the Contracting Officer for Proof Test requirements for materials with yield strengths greater than 60,000 psi (as this will typically require embedment depths greater than 12 diameters for cementitious or epoxy grouts).

Proof Load Table 60 ksi Deformed Reinforcing Bar		
Bar Size	Proof Load (kips)	Maximum Deflection (in.)
#3	5.28	0.075
#4	9.60	0.100

Proof Load Table 60 ksi Deformed Reinforcing Bar		
#5	14.88	0.125
#6	21.12	0.150
#7	28.80	0.175
#8	37.92	0.200
#9	48.00	0.225
Proof Load Table 30 ksi Stainless ASTM A193/A193M GR B8M Class 1 Threaded Rod		
Diameter (in.)	Proof Load (kips)	Maximum Deflection (in.)
3/8	2.65	0.075
1/2	4.71	0.100
5/8	7.36	0.125
3/4	10.60	0.150
7/8	14.43	0.175
1	18.85	0.200
1-1/4	29.45	0.250
Proof Load Table 36 ksi Anchor Rod (ASTM F1554, GR 36)		
Diameter (in.)	Proof Load (kips)	Maximum Deflection (in.)
3/8	3.18	0.075
1/2	5.65	0.100
5/8	8.84	0.125
3/4	12.72	0.150
7/8	17.32	0.175
1	22.62	0.200
1-1/4	35.34	0.250
Proof Load Table 55 ksi Anchor Rod (ASTM F1554, GR 55)		
Diameter (in.)	Proof Load (kips)	Maximum Deflection (in.)
3/8	4.86	0.075
1/2	8.64	0.100
5/8	13.50	0.125
3/4	19.44	0.150

Proof Load Table 55 ksi Anchor Rod (ASTM F1554, GR 55)		
7/8	26.46	0.175
1	35.56	0.200
1-1/4	54.00	0.250

Each field test report shall include the following:

- i. Installation date/time, test date/time, and anchor location shall be clearly identified for each anchor.
- ii. The concrete condition shall be documented.
- iii. Installation conditions including ambient air temperature and hole cleaning method, epoxy or cementitious grout product.
- iv. The power tool (brand, model number and size), drill bit (type and diameter), and the drilling mode.
- v. Anchorage geometry including diameter, embedment, spacing between testing anchors (if closer than 4 times embedment depth), and edge distance (if closer than 2 times embedment depth).
- vi. Test device, serial number, current calibration certificate.
- vii. Measured load and deflection compared to tables above.
- viii. Field test reports shall be prepared by the third party testing agency and signed by the special inspector. The special inspector shall forward the report to the Contracting officer within 3 days of the test.

3.4 BUILT-IN WORK

Where necessary and not otherwise indicated, form built-in metal work for anchorage with concrete or masonry. Provide built-in metal work in ample time for securing in place as the work progresses.

3.5 WELDING

Perform welding, welding inspection, and corrective welding in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation. Provide welded headed shear studs in accordance with AWS D1.1/D1.1M, Clause 7, except as otherwise specified. Provide in accordance with the safety requirements of EM 385-1-1.

3.6 DISSIMILAR METALS

Where dissimilar metals are in contact, protect surfaces with a coating in accordance with MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect in accordance with ASTM D1187/D1187M, asphalt-base emulsion. Clean surfaces with metal shavings from installation at the end of each work day.

3.7 PREPARATION

3.7.1 Material Coatings and Surfaces

Remove rust preventive coating just prior to field erection, using a remover approved by the metal manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

3.7.2 Cleaning of Stainless Steel.

Remove oil, paint and other foreign substances from stainless steel surfaces after fabrication. Perform cleaning by vapor degreasing or by the use of cleaners of the alkaline, emulsion or solvent type. After the surfaces have been cleaned give a final rinsing with clean water followed by a 24 hour period during which the surfaces are intermittently wet with clean water and then allowed to dry for the purpose of inspecting the clean surfaces. Visually inspect the surfaces for evidence of paint, oil, grease, welding slag, heat treatment scale, iron rust or other forms of contamination. If evidence of foreign substance is found, clean again in accordance with the applicable provisions of ASTM A380/A380M. Furnish the proposed method of treatment for approval. Visually reinspect after treatment. Use only stainless steel or nonmetallic bristle brushes to remove foreign substances. Remove any contamination occurring subsequent to the initial cleaning by one or more of the methods indicated above.

3.7.3 Environmental Conditions

Do not clean or paint surfaces when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than minus 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer. Metal surfaces to be painted must be dry for a minimum of 48 hours prior to the application of primer or paint.

3.8 COVER PLATES AND FRAMES

Provide tops of cover plates and frames flush with finished surface. Test for trip hazards and adjust for any encountered lippage. Gap between cover plate and frame must not exceed 1/4 inch.

Demonstrate to the Contracting officer performance of the pier utility trench cover plate lifting slings, and provide three sets of four-leg chain lifting slings for each trench cover plate size.

3.9 INSTALLATION OF BOLLARDS/PIPE GUARDS/GUARD POSTS

Set bollards/pipe guards/guard posts vertically in concrete piers. Fill hollow cores with concrete having a compressive strength of 3000 psi.

3.10 INSTALLATION OF SAFETY LADDERS

Secure to the adjacent construction as indicated on drawings.

3.11 MOUNTING OF SAFETY CHAINS

Provide safety chains where indicated. Mount the top chain 3 feet 6 inches above the finished floor and mount the lower chain 2 feet above the finished floor.

3.12 Installation of Guard Railing

Install guard railing by means of post installed anchors. Provide expansion joints at 30 ft centers which must align with structure expansion joints. If BID OPTIONS are not executed, provide infil guard railing as indicated on bulkhead with expansion joints aranged to allow for placement of the options.

-- End of Section --

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SECTION 05 51 00

METAL STAIRS

02/17, CHG 1: 05/17

PART 1 GENERAL

Section 05 05 23.16 STRUCTURAL WELDING applies to work specified in this section.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 314 (1990; R 2013) Standard Specification for
Steel Anchor Bolts

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2016) Specification for Structural Steel
Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121 (2007) Standard Definitions for Use in the
Design of Steel Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts
and Screws (Inch Series)

ASME B18.6.1 (2016) Wood Screws (Inch Series)

ASME B18.6.3 (2013; R 2017) Machine Screws, Tapping
Screws, and Machine Drive Screws (Inch
Series)

ASME B18.21.1 (2009; R 2016) Washers: Helical
Spring-Lock, Tooth Lock, and Plain Washers
(Inch Series)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding
Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon
Structural Steel

ASTM A47/A47M (1999; R 2018; E 2018) Standard

Specification for Ferritic Malleable Iron Castings

ASTM A48/A48M	(2003; R 2021) Standard Specification for Gray Iron Castings
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A108	(2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A449	(2014; R 2020) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A500/A500M	(2021a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A512	(2006; R 2012) Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
ASTM A568/A568M	(2019a) Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A575	(2020) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A1008/A1008M	(2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1011/A1011M	(2018a) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon,

Structural, High-Strength Low-Alloy,
High-Strength Low-Alloy with Improved
Formability, and Ultra-High Strength

ASTM C514	(2004; R 2020) Standard Specification for Nails for the Application of Gypsum Board
ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2021) Life Safety Code
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal Stair System; G

SD-03 Product Data

Masonry Anchorage Devices

Protective Coating

Steel Pan Stairs; G

Steel Stairs

SD-07 Certificates

Welding Procedures

Welder Qualification

Recycled Content; S

Regional Material; S

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Sourcing of Raw Materials

Provide recycled content certifications of applicable products.

Provide regional material certifications of applicable materials.

1.4 QUALITY CONTROL

1.4.1 Qualifications for Welding Work

Submit welding procedures in accordance with AWS D1.1/D1.1M. Make test specimens in the presence of the Contracting Officer, and have the specimens tested by an approved testing laboratory at the Contractor's expense.

Certify welder qualification by tests in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. In addition, perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, ensure that two test welds are retested immediately and that each test weld is made and passes. Failure in the immediate retest requires that the welder be retested after further practice or training and a complete set of test welds be made.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Specification includes concrete filled steel pan interior stairs.

2.2 FABRICATION

Preassemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, before cleaning and treating surfaces and applying surface finishes, including zinc coatings.

2.2.1 General Fabrication

Prepare and submit metal stair system shop drawings with detailed plans and elevations at scales not less than 1 inch to 1 foot and with details of sections and connections at scales not less than 3 inches to 1 foot. Also detail the placement drawings, diagrams, and templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchorage devices.

Use materials of size and thicknesses indicated or, if not indicated, of the size and thickness necessary to produce a finished product that is strong enough and durable enough for its intended use. Work the materials to the dimensions indicated on approved detail drawings, using proven methods of fabrication and support. Use the type of materials indicated or specified for the various components of work.

Form exposed work true to line and level, with accurate angles and surfaces and with straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch, and bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Continuously weld corners and seams in accordance with the recommendations

of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flat-head (countersunk) screws or bolts.

Provide and coordinate anchorage of the type indicated for the supporting structure. Fabricate anchoring devices, and space them as indicated and as necessary to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified as fabricated from cold-finished or cold-rolled stock.

2.2.2 Steel Pan Stairs

2.2.2.1 General

Joining pieces by welding. Fabricate units so that bolts and other fastenings do not appear on finished surfaces. Make joints true and tight, and connections between parts lighttight. Grind continuous welds smooth where exposed.

Construct metal stair units to sizes and arrangements indicated to support a minimum live load of 100 pounds per square foot. Provide framing, hangers, columns, struts, clips, brackets, bearing plates, and other components as required for the support of stairs and platforms.

2.2.2.2 Stair Framing

Fabricate stringers of structural steel channels, or plates, or a combination thereof as indicated. Provide closures for exposed ends of strings.

Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt headers to stringers and newels, and bolt framing members to stringers and headers.

2.2.2.3 Riser, Subtread, and Subplatform Metal Pans

Form metal pans of 0.1084-inch (12-gage) structural steel sheets, conforming to ASTM A1011/A1011M, Grade 36. Shape the pans to the configuration indicated.

Construct risers and subtread metal pans with steel angle supporting brackets, of the size indicated, welded to stringers. Secure metal pans to brackets with rivets or welds. Secure subplatform metal pans to platform frames with welds.

2.2.2.4 Steel Framing for Concrete Stairs

When necessary, modify fabricated units to fit actual dimensions of the supporting structure. Join steel components by welding. Provide 14-gage steel risers unless otherwise indicated. Arrange components to receive finish materials as indicated.

2.2.3 Protective Coating

Shop-prime steelwork as indicated in accordance with AISC/AISI 121, except surfaces of steel encased in concrete; welded surfaces; high-strength, bolt-connected surfaces; and surfaces of crane rails.

2.3 COMPONENTS

2.3.1 Steel Stairs

Provide steel stairs complete with stringers, metal-pan concrete-filled treads, landings, columns, handrails, and necessary bolts and other fastenings. Shop-paint steel stairs and accessories.

2.3.1.1 Design Loads

Design stairs to sustain a live load of not less than 100 pounds per square foot, or a concentrated load of 300 applied where it is most critical. Except for a commercial product, design and fabricate steel stairs to conform to AISC 360. Design fire stairs to conform to NFPA 101.

2.3.1.2 Materials

Provide steel stairs of welded construction except that bolts may be used where welding is not practicable. Do not use screw or screw-type connections.

- a. Structural Steel: ASTM A36/A36M.
- b. Support metal pan for concrete fill on angle cleats welded to stringers or treads with integral cleats, welded or bolted to the stringer. Close exposed ends.
- c. Before fabrication, obtain necessary field measurements and verify drawing dimensions.
- d. Clean metal surfaces free of mill scale, flake rust, and rust pitting before shop finishing. Weld permanent connections. Finish welds flush and smooth on surfaces that will be exposed after installation.

2.3.2 Soffit Clips

Provide clips with holes for attaching metal furring for plastered soffits. Space the clips not more than 12 inches on center, and weld them to stair treads and platforms as required.

2.3.3 Masonry Anchorage Devices

Provide masonry anchorage devices consisting of expansion shields complying with AASHTO M 314, ASTM E488/E488M and ASTM C514 as follows:

- a. Lead expansion shields for machine screws and bolts 1/4 inch and smaller; head-out embedded-nut type, single unit class, Group I, Type 1, Class 1.
- b. Lead expansion shields for machine screws and bolts larger than 1/4 inch in size; head-out embedded-nut type, multiple unit class, Group I, Type 1, Class 2.

- c. Bolt anchor expansion shields for lag bolts; zinc-alloy, long-shield anchors class, Group II, Type 1, Class 1.
- d. Bolt anchor expansion shields for bolts; closed-end bottom-bearing class, Group II, Type 2, Class 1.

Use toggle bolts of the tumble-wing type, conforming to ASTM A325, ASTM A449, and ASTM C636/C636M, type, class, and style as required.

2.3.4 Fasteners

Select galvanized zinc-coated fasteners conforming to ASTM A153/A153M for exterior applications or where the fasteners are built into exterior walls or floor systems. Select the fasteners for the type, grade, and class required for the installation of steel stair items:

- a. Standard/regular hexagon-head bolts and nuts, conforming to ASTM A307, Grade A.
- b. Square-head lag bolts conforming to ASME B18.2.1.
- c. Cadmium-plated steel machine screws, conforming to ASME B18.6.3.
- d. Flat-head carbon steel wood screws, conforming to ASME B18.6.1.
- e. Plain, round, general-assembly-grade, carbon steel washers, conforming to ASME B18.21.1.
- f. Helical-spring, carbon steel lockwashers, conforming to ASME B18.2.1.

2.4 MATERIALS

2.4.1 Structural Steel Plates, Shapes and Bars

Structural size shapes and plates, conforming to ASTM A36/A36M, unless otherwise noted, except bent or cold-formed plates.

Steel plates - bent or cold-formed, conforming to ASTM A283/A283M, Grade C.

Steel bars and bar-size shapes, conforming to ASTM A36/A36M, unless otherwise noted for steel bars and bar-size shapes.

2.4.2 Structural Steel Tubing

Provide the following:

- a. Structural steel tubing, hot-formed, welded or seamless, conforming to ASTM A500/A500M, Grade C, unless otherwise noted.

2.4.3 Hot-Rolled Carbon Steel Bars

Provide the following:

- a. Hot-rolled carbon steel bars and bar-size shapes, conforming to ASTM A575, grade as selected by the fabricator.

2.4.4 Cold-Finished Steel Bars

Provide the following:

- a. Cold-finished steel bars conforming to ASTM A108, grade as selected by the fabricator.

2.4.5 Hot-Rolled Carbon Steel Sheets and Strips

Provide the following:

- a. Hot-rolled carbon sheets and strips conforming to ASTM A568/A568M and ASTM A1011/A1011M, pickled and oiled.

2.4.6 Cold-Rolled Carbon Steel Sheets

Provide the following:

- a. Cold-rolled carbon steel sheets conforming to ASTM A1008/A1008M.

2.4.7 Cold-Drawn Steel Tubing

Provide the following:

- a. Cold-drawn steel tubing conforming to ASTM A512, sunk drawn, butt-welded, cold-finished, and stress-relieved.

2.4.8 Gray Iron Castings

Provide the following:

- a. Gray iron castings conforming to ASTM A48/A48M, Class 30.

2.4.9 Malleable Iron Castings

Provide the following:

- a. Malleable iron castings conforming to ASTM A47/A47M, grade as selected.

2.4.10 Steel Pipe

Provide the following:

- a. Steel pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

PART 3 EXECUTION

3.1 PREPARATION

Clean surfaces thoroughly before installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Examine materials upon arrival at site. Notify the carrier and manufacturer of any damage.

Protect installed products until completion of project. Touch up, repair or replace, damaged products before substantial completion

3.2 INSTALLATION

Install in accordance with the manufacturer's instructions and approved

submittals. Install in proper relationship with adjacent construction.

Install items at locations indicated, according to the manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Ensure that exposed fastenings are compatible with generally match the color and finish of, and harmonize with the material to which they are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners is cause for rejection. Conceal fastenings where practicable. Select thickness of metal and details of assembly and supports that adequately strengthen and stiffen the construction. Form joints exposed to the weather to exclude water.

3.2.1 Field Preparation

Remove rust-preventive coating just before field erection, using a remover approved by the coating manufacturer. Provide surfaces, when assembled, free of rust, grease, dirt and other foreign matter.

3.2.2 Field Welding

Comply with AWS D1.1/D1.1M in executing manual shielded-metal arc welding, (for appearance and quality of new welds) and in correcting existing welding.

3.2.3 Touchup Painting

Immediately after installation, clean all field welds, bolted connections, and abraded areas of the shop-painted material, and repaint exposed areas with the same paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 2 mils.

-- End of Section --

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SECTION 05 51 33

METAL LADDERS

02/16

PART 1 GENERAL

1.1 INTRODUCTION

This section provides performance based design for all ladders in the project, except waterfront ladders. See specification 05 50 13 for waterfront ladder specifications.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN LADDER INSTITUTE (ALI)

ALI A14.3 (2008; R 2018) Ladders - Fixed - Safety Requirements

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

ASTM A47/A47M (1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings

ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A500/A500M (2021a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

MASTER PAINTERS INSTITUTE (MPI)

MPI 79 (2016) Primer, Alkyd, Anti-Corrosive for Metal

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3 (2018) Power Tool Cleaning

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.23

(Nov 2016) Ladders

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Ladders, Installation Drawings

SD-03 Product Data

Telescoping Safety Post

SD-07 Certificates

Fabricator Certification for Ladder Assembly

Recycled Content; S

Regional Material; S

1.3.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1.1 M&R Sourcing of Raw Materials

Provide recycled content certifications of steel products.

Provide regional material certifications of applicable materials.

1.4 CERTIFICATES

Provide fabricator certification for ladder assembly stating that the ladder and associated components have been fabricated according to the requirements of 29 CFR 1910.23.

1.5 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.6 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A36/A36M.

2.1.2 Structural Tubing

ASTM A500/A500M.

2.1.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

2.2 FABRICATION FINISHES

2.2.1 Shop Cleaning and Painting

2.2.1.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean.

2.2.1.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.2 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.3 LADDERS

Fabricate vertical ladders conforming to 29 CFR 1910.23 and Section 5 of ALI A14.3. Ladders shall be capable of supporting their maximum intended load. Use 2 1/2 by 3/8 inch steel flats for stringers and 3/4 inch diameter steel rods for rungs. Ladder rungs, step and cleats must be spaced not less than 10 inches and not more than 16 inches wide (measured before installation of ladder safety system), spaced no more than 14 inches apart, plug welded or shouldered and headed into stringers. Install ladders so that the maximum perpendicular distance from the centerline of the steps or rungs, or grab bars, or both, to the nearest permanent object in the back of the ladder or to the finished wall surface will not be less than 7 inches, except for the elevator pit ladders, which have a minimum perpendicular distance of 4.5 inches. Provide heavy clip angles riveted

or bolted to the stringer and drilled for not less than two 1/2 inch diameter expansion bolts as indicated. Provide intermediate clip angles not over 48 inches on centers. The top rung of the ladder must be level with the top of the access level, parapet or landing served by the ladder except for hatches or wells. Extend the side rails of through or side step ladders 42 inches above the access level. Provide ladder access protective swing gates at the top of access/egress level. Provide telescoping safety post permanently mounted to the top two rungs of the roof ladder. The shop drawings must indicate ladder locations and details of critical dimensions and materials.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Provide Exposed fastenings of compatible materials, generally matching in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners will be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports must provide strength and stiffness. Formed joints exposed to the weather to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Metalwork must be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching must produce clean true lines and surfaces. Continuously weld along the entire area of contact. Do not tack weld exposed connections of work in place. Grid smooth exposed welds. Provide smooth finish on exposed surfaces of work in place, unless otherwise approved. Where tight fits are required, mill joints. Cope or miter corner joints, well formed, and in true alignment. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion anchors, and powder-actuated fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine bolts, carriage bolts and powder-actuated threaded studs for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action.

3.5.2 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

3.6 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Secure to masonry or concrete with not less than two 1/2 inch diameter expansion bolts. Install intermediate clip angles not over 48 inches on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. Ends of ladders must not rest upon floor.

-- End of Section --

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SECTION 05 52 00

METAL RAILINGS

02/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2605 (2020) Voluntary Specification,
Performance Requirements and Test
Procedures for Superior Performing Organic
Coatings on Aluminum Extrusions and Panels

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 314 (1990; R 2013) Standard Specification for
Steel Anchor Bolts

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts
and Screws (Inch Series)

ASME B18.6.1 (2016) Wood Screws (Inch Series)

ASME B18.6.3 (2013; R 2017) Machine Screws, Tapping
Screws, and Machine Drive Screws (Inch
Series)

ASME B18.21.1 (2009; R 2016) Washers: Helical
Spring-Lock, Tooth Lock, and Plain Washers
(Inch Series)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding
Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A27/A27M (2020) Standard Specification for Steel
Castings, Carbon, for General Application

ASTM A36/A36M (2019) Standard Specification for Carbon
Structural Steel

ASTM A47/A47M (1999; R 2018; E 2018) Standard
Specification for Ferritic Malleable Iron
Castings

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A500/A500M	(2021a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM B26/B26M	(2018; E 2018) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B429/B429M	(2010; E 2012) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C514	(2004; R 2020) Standard Specification for Nails for the Application of Gypsum Board
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521	(2001; R 2012) Pipe Railing Systems Manual
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1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Preinstallation Meetings

Within 30 days of contract award, submit fabrication drawings for the following items:

- a. Steel shapes, plates, bars and strips
- b. Steel railings and handrails
- c. Aluminum railings and handrails

d. Anchorage and fastening systems

Submit manufacturer's catalog data, including two copies of manufacturers specifications, load tables, dimension diagrams, and anchor details for the following items:

- a. Concrete inserts
- b. Masonry anchorage devices
- c. Steel railings and handrails
- d. Aluminum railings and handrails
- e. Anchorage and fastening systems

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G

SD-03 Product Data

Structural-Steel Plates, Shapes, and Bars; G

Concrete Inserts; G

Masonry Anchorage Devices; G

Steel Railings and Handrails; G

Aluminum Railings and Handrails; G

Anchorage and Fastening Systems; G

SD-04 Samples

Finish Samples; G

SD-07 Certificates

Welding Procedures; G

Welder Qualification; G

SD-08 Manufacturer's Instructions

Installation Instructions

Recycled Content; S

Regional Material; S

1.3.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1.1 M&R Sourcing of Raw Materials

Provide recycled content certifications of applicable products.

Provide regional material certifications of applicable materials.

1.4 QUALITY CONTROL

1.4.1 Welding Procedures

Section 05 05 23.16 STRUCTURAL WELDING applies to work specified in this section.

Submit results of welding procedures testing in accordance with AWS D1.1/D1.1M made in the presence of the Contracting Officer and by an approved testing laboratory at the Contractor's expense.

1.4.2 Welder Qualification

Submit certified welder qualification by tests in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. In addition, perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, conduct an immediate retest of two test welds and ensure that each test weld passes. Failure in the immediate retest will require that the welder be retested after further practice or training and make a complete set of test welds.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 General

Cable railing systems shall withstand structural loading as determined by allowable design working stresses of materials based on the following standards

- a. Aluminum: AA SAS-30.
- b. Stainless Steel: ASCE 8.

1.5.2 Structural Performance

Provide cable railing systems capable of withstanding the following structural loads without exceeding allowable design working stress of materials for handrails, railings, anchors, and connections:

- a. Top Rail: Shall withstand the following loads: Concentrated load of 200 lbf applied at any point and in any direction. Uniform load of 50 lbf-ft. Applied horizontally and concurrently with uniform load of 100 lbf-ft. Applied vertically downward. Concentrated and uniform loads above need not be assumed to act concurrently.
- b. Handrails Not Serving As Top Rails: Shall withstanding the following loads: Concentrated load of 200 lbf applied at any point and in any

direction. Uniform load of 50 lbf-ft. applied in any direction. Concentrated and uniform loads above need not be assumed to act concurrently.

- c. Guard Infill Area: Shall withstand the following loads: Concentrated horizontal load of 200 lbf applied to 1 square foot at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area. Loads need not be assumed to act concurrently with loads on top rails in determining stress on guard.

1.5.3 Thermal Movements

Cable railing systems shall allow for movements resulting from 120 deg F changes in ambient and 180 deg F surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heatloss.

1.5.4 Corrosion Resistance

Separate incompatible materials to prevent galvanic corrosion.

1.6 FINISH SAMPLES

Color Selection: Submit color as indicated on drawings.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content. Provide certificates of compliance for recycled content.

2.2 FABRICATION

Preassemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, before cleaning, treating, and applying surface finishes, including zinc coatings.

Provide railing and handrail detail plans and elevations at not less than 1 inch to 1 foot. Provide details of sections and connections at not less than 3 inches to 1 foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.

Use materials of size and thicknesses indicated or, if not indicated, of the size and thickness necessary to produce adequate strength and durability in the finished product for its intended use. Work the materials to the dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use the type of materials indicated or specified for the various components of work.

Form exposed work true to line and level, with accurate angles and surfaces and straight sharp edges. Ensure that all exposed edges are

eased to a radius of approximately 1/32 inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form the exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use countersunk Phillips flathead screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

2.2.1 Aluminum Railings

Fabrication: Provide fabrication jointing by one of the following methods:

- a. Use flush-type rail fittings, welded and ground smooth with splice locks secured with 3/8 inch recessed-head set screws.
- b. Ensure that mitered and welded joints made by fitting; post to top rail; and corners, are groove welded and ground smooth. Where allowed by the Contracting Officer, provide butt splices reinforced by a tight-fitting dowel or sleeve not less than 6 inches in length. Tack-weld or epoxy-cement the dowel or sleeve to one side of the splice.
- c. Assemble railings using slip-on aluminum-magnesium alloy fittings for joints. Fasten fittings to pipe or tube with 1/4 or 3/8 inch stainless-steel recessed-head setscrews. Provide assembled railings with fittings only at vertical supports or at rail terminations attached to walls. Provide expansion joints at the midpoint of panels. Provide a setscrew in only one side of the slip-on sleeve. Provide alloy fittings to conform to ASTM B26/B26M.

2.2.2 Steel Handrails

Fabricate joint posts, rail, and corners by one of the following methods:

- a. Flush-type rail fittings of commercial standard, welded and ground smooth, with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.
- b. Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove-welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight-fitting interior sleeve not less than 6 inches long.
- c. Railings may be bent at corners in lieu of jointing, provided that bends are made in suitable jigs and the pipe is not crushed.

2.3 COMPONENTS

2.3.1 Metals

Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.

2.3.1.1 Aluminum

Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy and temper designated below for each aluminum form required.

- a. Extruded Bar and Tube: ASTM B221/B221M, Alloy 6063-T5/T52.
- b. Extruded Structural Pipe and Tube: ASTM B429/B429M, Alloy 6063-T832.
- c. Drawn Seamless Tube: ASTM B210/B210M, Alloy 6063-T832.
- d. Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
- e. Die and Hand Forgings: ASTM B247/B247M, Alloy 6061-T6.
- f. Castings: ASTM B26/B26M, Alloy A356-T6.

2.3.1.2 Stainless Steel

Provide grade and type designated below for each form required:

- a. Castings: ASTM A743/A743M, Grade CF 8M.
- b. Plate: ASTM A666, Type 316L.
- c. Wire Rope: 1-by-19 cable conforming to ASTM A492, Type 316.

2.3.1.3 Brackets, Flanges, and Anchors

Provide cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

- a. Provide cast brackets with flange tapped for concealed anchorage to threaded hanger bolt.
- b. Provide formed or cast brackets with predrilled hole for exposed bolt anchorage.
- c. Provide formed steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.
- d. Provide brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.

2.3.1.4 Wire Rope Fittings

Provide connectors of types indicated, fabricated from stainless steel,

and with capability to sustain, without failure, a load equal to the minimum breaking strength of the wire rope with which they are used.

2.3.2 Structural Steel Plates, Shapes And Bars

Provide structural-size shapes and plates, except plates to be bent or cold-formed, conforming to ASTM A36/A36M, unless otherwise noted.

Provide steel plates, to be bent or cold-formed, conforming to ASTM A283/A283M, Grade C.

Provide steel bars and bar-size shapes conforming to ASTM A36/A36M, unless otherwise noted.

2.3.3 Steel Pipe

Provide pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.3.4 Concrete Inserts

Provide threaded-type concrete inserts consisting of galvanized ferrous castings, internally threaded to receive 3/4 inch diameter machine bolts; either malleable iron conforming to ASTM A47/A47M or cast steel conforming to ASTM A27/A27M, hot-dip galvanized in accordance with ASTM A153/A153M.

Provide wedge-type concrete inserts consisting of galvanized box-type ferrous castings designed to accept 3/4 inch diameter bolts having special wedge-shaped heads, made of either malleable iron conforming to ASTM A47/A47M or cast steel conforming to ASTM A27/A27M and hot-dip galvanized in accordance with ASTM A153/A153M.

Provide carbon steel bolts having special wedge-shaped heads, nuts, washers, and shims, galvanized in accordance with ASTM A153/A153M. Provide slotted-type concrete inserts consisting of a galvanized 1/8 inch thick pressed-steel plate conforming to ASTM A283/A283M, made of box-type welded construction with a slot designed to receive 3/4 inch diameter square-head bolt with knockout cover; and hot-dip galvanized in accordance with ASTM A123/A123M.

2.3.5 Masonry Anchorage Devices

Provide masonry anchorage devices consisting of expansion shields complying with AASHTO M 314, ASTM E488/E488M and ASTM C514 as follows:

Provide lead expansion shields for machine screws and bolts 1/4 inch and smaller; head-out embedded nut type, single-unit class, Group I, Type 1, Class 1.

Provide lead expansion shields for machine screws and bolts larger than 1/4 inch in size; head-out embedded nut type, multiple-unit class, Group I, Type 1, Class 2.

Provide bolt anchor expansion shields for lag bolts; zinc-alloy, long-shield anchor class, Group II, Type 1, Class 1.

Provide bolt anchor expansion shields for bolts; closed-end bottom-bearing class, Group II, Type 2, Class 1.

2.3.6 Fasteners

Provide galvanized zinc-coated fasteners in accordance with ASTM A153/A153M used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.

Provide standard hexagon-head bolts, conforming to ASTM A307, Grade A.

Provide square-head lag bolts conforming to ASME B18.2.1.

Provide cadmium-plated steel machine screws conforming to ASME B18.6.3.

Provide flat-head carbon steel wood screws conforming to ASME B18.6.1.

Provide plain round, general-assembly-grade, carbon steel washers conforming to ASME B18.21.1.

Provide helical spring, carbon steel lockwashers conforming to ASME B18.2.1.

2.3.6.1 Handrail Anchors

Select fasteners of type, grade and class required to produce connections suitable for anchoring cable railing systems to other types of construction indicated and capable of withstanding design loads.

2.3.6.2 Handrail and Railing Component Anchors

Use fasteners fabricated from same basic metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

- a. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are standard fastening method for handrail and railing indicated.
- b. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

2.3.7 Steel Railings And Handrails

Design handrails to resist a concentrated load of 200 lb in any direction at any point of the top of the rail or 50 lb per foot applied horizontally to the top of the rail, whichever is more severe. NAAMM AMP 521, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts. Provide stainless steel cable guardrail infill concealed mechanical fasteners and fittings.

2.3.7.1 Steel Handrails

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A53/A53M or structural tubing conforming to ASTM A500/A500M, Grade A or B of equivalent strength. Provide steel railings of 1 1/2 inch nominal size, shop-painted.

2.3.8 Aluminum Railings And Handrails

Provide railings and handrails consisting of schedule 40 pipe ASTM B429/B429M, and aluminum semihollow tube with rounded corners ASTM B221. Ensure that all fasteners are Series 300 stainless steel. Provide stainless steel cable railing with railing manufacturer's standard concealed mechanical fasteners and fittings.

2.3.8.1 Extruded Aluminum Components

Provide manufacturer's standard extruded aluminum components as follows:

- a. Standard Post: Square with radiused corner, 0.100-inch wall thickness.
- b. Top Rail: Rectangular cross section, radiused edge
- c. Handrail: As shown on drawings.

2.3.8.2 Aluminum Finish

2.3.8.2.1 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a high-performance finish in accordance with AAMA 2605 with total dry film thickness of not less than 1.2 mils. Provide custom color as indicated on drawings.

2.3.8.3 Stainless Steel Finish

As fabricated mill finish.

PART 3 EXECUTION

3.1 PREPARATION

Adjust stair railings and handrails before securing in place in order to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 8 feet on center. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

- a. Anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves of galvanized, standard-weight, steel pipe, not less than 6 inches long, and having an inside diameter not less than 1/2 inch greater than the outside diameter of the inserted pipe post. Provide steel plate closure secured to the bottom of the sleeve, with closure width and length not less than 1 inch greater than the outside diameter of the sleeve. After posts have been inserted into sleeves, fill the annular space between the post and sleeve with nonshrink grout or a quick-setting hydraulic cement. Cover anchorage joint with a round steel flange welded to the post.
- b. Anchor posts to steel with oval steel flanges, angle type or floor type as required by conditions, welded to posts and bolted to the steel supporting members.
- c. Anchor rail ends into concrete and masonry with round steel flanges welded to rail ends and anchored into the wall construction with lead expansion shields and bolts.

- d. Anchor rail ends to steel with oval or round steel flanges welded to tail ends and bolted to the structural-steel members.

Secure handrails to walls by means of wall brackets and wall return fitting at handrail ends. Provide brackets of malleable iron castings, with not less than 3 inch projection from the finished wall surface to the center of the pipe, drilled to receive one 3/8 inch bolt. Locate brackets not more than 60 inches on center. Provide wall return fittings of cast iron castings, flush type, with the same projection as that specified for wall brackets. Secure wall brackets and wall return fittings to building construction as follows:

- a. For concrete and solid masonry anchorage, use bolt anchor expansion shields and lag bolts.

Install toe boards and brackets where indicated. Make splices, where required, at expansion joints.

3.2 INSTALLATION

Submit manufacturer's installation instructions for the following products to be used in the fabrication of stair railing and hand rail work:

- a. Masonry anchorage devices
- b. Steel railings and handrails
- c. Aluminum railings and handrails
- d. Anchorage and fastening systems

3.2.1 Steel Handrail

Install handrail by means of masonry with expansion shields and bolts or toggle bolts or by means of base plates bolted to stringers or structural-steel frame work.

3.2.2 Aluminum Handrail

Provide Series 300 stainless-steel bolts to anchor aluminum alloy flanges, of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or concrete, coat the contact surface with a heavy coating of bituminous paint.

3.2.3 Touchup Painting

Immediately after installation, clean field welds, bolted connections, abraded areas of the shop paint, and exposed areas painted with the paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 2 mils.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Welding

Ensure that procedures of manual shielded metal arc welding, appearance

and quality of welds made, and methods used in correcting welding work
comply with AWS D1.1/D1.1M.

-- End of Section --

SECTION 06 10 00

ROUGH CARPENTRY

08/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20 (2020) American Softwood Lumber Standard

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION
(AREMA)

AREMA Eng Man (2017) Manual for Railway Engineering

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts
and Screws (Inch Series)

ASME B18.2.2 (2015) Nuts for General Applications:
Machine Screw Nuts, Hex, Square, Hex
Flange, and Coupling Nuts (Inch Series)

ASME B18.5.2.1M (2006; R 2011) Metric Round Head Short
Square Neck Bolts

ASME B18.5.2.2M (1982; R 2010) Metric Round Head Square
Neck Bolts

ASME B18.6.1 (2016) Wood Screws (Inch Series)

AMERICAN WOOD COUNCIL (AWC)

AWC NDS (2015) National Design Specification (NDS)
for Wood Construction

AWC WFCM (2012) Wood Frame Construction Manual for
One- and Two-Family Dwellings

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA BOOK (2015) AWPA Book of Standards

AWPA M2 (2019) Standard for the Inspection of
Preservative Treated Wood Products for
Industrial Use

AWPA M6 (2018) Brands Used on Preservative Treated
Materials

AWPA P5	(2015) Standard for Waterborne Preservatives
AWPA P18	(2014) Nonpressure Preservatives
AWPA P49	(2015) Standard for Fire Retardant FR-1
AWPA T1	(2021) Use Category System: Processing and Treatment Standard
AWPA U1	(2021) Use Category System: User Specification for Treated Wood

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA E445	(2002) Performance Standards and Qualification Policy for Structural-Use Panels (APA PRP-108)
APA F405	(19) Product Guide: Performance Rated Panels
APA L870	(2010) Voluntary Product Standard, PS 1-09, Structural Plywood
APA S350	(2014) PS 2-10, Performance Standard for Wood-Based Structural-Use Panels

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM D2898	(2010; R 2017) Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM F547	(2017) Standard Terminology of Nails for Use with Wood and Wood-Base Materials
ASTM F1667	(2018a) Standard Specification for Driven Fasteners: Nails, Spikes, and Staples

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor
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Sources using Environmental Chambers

FM GLOBAL (FM)

FM 4435 (2013) Roof Perimeter Flashing

GREEN SEAL (GS)

GS-36 (2013) Adhesives for Commercial Use

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules (2015) Rules for the Measurement & Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules (2013) Standard Grading Rules for Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD ASSOCIATION (CRA)

RIS Grade Use (1998) Redwood Lumber Grades and Uses

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec (1986; Supple. No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003 (2014) Standard Grading Rules for Southern Pine Lumber

U.S. DEPARTMENT OF COMMERCE (DOC)

DOC/NIST PS56 (1973) Structural Glued Laminated Timber

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1923 (Rev A; Notice 3) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

CID A-A-1924 (Rev A; Notice 3) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors)

CID A-A-1925 (Rev A; Notice 3) Shield Expansion (Nail

Anchors)

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (2015) Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5 (2017) Western Lumber Grading Rules

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Nailers and Nailing Strips; G

Drawings of field erection details, including materials and methods of fastening nailers in conformance with Factory Mutual wind uplift rated systems specified in other Sections of these specifications.

SD-03 Product Data

Fire-retardant Treatment

Adhesives

SD-06 Test Reports

Preservative-treated Lumber and Plywood

SD-07 Certificates

EPD(s); S

Recycled Content; S

Forest Stewardship Council (FSC); S

Regional Material; S

VOC Emissions; S

Legal Wood; S

Certified Sustainably Harvested Virgin Lumber; S

Certified Sustainably Harvested Framing Lumber; S

Certified Sustainably Harvested Plywood for Other Uses; S

Preservative Treatment

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 SM&R Sourcing of Raw Materials

Provide recycled content certifications applicable materials.

Provide Forest Stewardship Council (FSC) certification for wood products.

Provide regional material certifications for all materials that apply.

1.2.1.3 IEQ Low-Emitting Materials

For Composite Wood applied inside the weatherproofing system submit VOC emissions statement indicating compliance with the;

a. Formaldehyde Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

1.2.1.4 Pilot Credit Legal Wood

Submit product data verifying product is from Legal and Responsible Sources per ASTM D7612-10 as required to achieve LEED credit.

Certified Sustainably Harvested Plywood

1.3 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store, protect, handle, and install prefabricated structural elements in accordance with manufacturer's instructions and as specified. Store materials off the ground to provide proper ventilation, with drainage to avoid standing water, and protection against ground moisture and dampness. Store materials with a moisture barrier at both the ground level and as a cover forming a well ventilated enclosure. Store wood I-beams and glue-laminated beams and joists on edge. Adhere to requirements for stacking, lifting, bracing, cutting, notching, and special fastening requirements. Do not use materials that have visible moisture or biological growth. Remove defective and damaged materials and provide new materials. Store separated reusable wood waste convenient to cutting station and area of work.

1.4 GRADING AND MARKING

1.4.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency must be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Surfaces that are to be exposed to view must not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

1.4.2 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark must identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with APA L870. Surfaces that are to be exposed to view must not bear grademarks or other types of identifying marks.

1.4.3 Preservative-Treated Lumber and Plywood

The Contractor is responsible for the quality of treated wood products. Each treated piece must be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor must provide Contracting Officer's Representative (COR) with the inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.4.4 Fire-Retardant Treated Lumber

Mark each piece in accordance with AWPA M6, except pieces that are to be natural or transparent finished. In addition, exterior fire-retardant lumber must be distinguished by a permanent penetrating blue stain. Labels of a nationally recognized independent testing agency will be accepted as evidence of conformance to the fire-retardant requirements of AWPA M6.

1.5 SIZES AND SURFACING

ALSC PS 20 for dressed sizes of yard and structural lumber. Lumber must be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes must be within manufacturing tolerances allowed by the standard under which the product is produced. Other measurements are IP or SI standard.

1.6 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products must be as follows at the time of delivery to the job site:

- a. Framing lumber and board, 19 percent maximum

1.7 PRESERVATIVE TREATMENT

Treat wood products with waterborne wood preservatives conforming to AWPA P5. Pressure treatment of wood products must conform to the requirements of AWPA BOOK Use Category System Standards U1 and T1. Pressure-treated wood products must not contain arsenic, chromium, or other agents classified as carcinogenic, probably carcinogenic, or possibly carcinogenic to humans (compounds in Groups 1, 2A, or 2B) by the International Agency for Research on Cancer (IARC), Lyon, France. Pressure-treated wood products must not exceed the limits of the U.S. EPA's Toxic Characteristic Leaching Procedure (TCLP), and must not be classified as hazardous waste. Submit certification from treating plant stating chemicals and process used and net amount of preservatives retained are in conformance with specified standards. In accordance with AWPA U1 provide non-copper preservative treatment such as EL2, PTI or SBX, DOT for products in direct contact with sheet metal.

- a. 0.25 pcf intended for above ground use.
- b. 0.40 pcf intended for ground contact and fresh water use. 0.60 pcf intended for Ammoniacal Copper Quaternary Compound (ACQ)-treated foundations. 0.80 to 1.00 pcf intended for ACQ-treated pilings. All wood must be air or kiln dried after treatment. Specific treatments must be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Do not incise surfaces of lumber that will be exposed. Minimize cutting and avoid breathing sawdust. Brush coat areas that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. The following items must be preservative treated:
 - (1) Wood framing, woodwork, and plywood up to and including the subflooring at the first-floor level of structures having crawl spaces when the bottoms of such items are 24 inches or less from the earth underneath.
 - (2) Wood members that are in contact with water.
 - (3) Exterior wood steps, platforms, and railings; and all wood framing of open, roofed structures.
 - (4) Wood sills, soles, plates, furring, and sleepers that are less than 24 inches from the ground, furring and nailers that are set into or in contact with concrete or masonry.
 - (5) Nailers, edge strips, crickets, curbs, and cants for roof decks.

1.7.1 New Construction

Use a boron-based preservative conforming to AWPA P18, sodium silicate wood mineralization process, or Ammoniacal Copper Quaternary Compound to treat wood. Use boron-based preservatives for above-ground applications only.

1.8 FIRE-RETARDANT TREATMENT

Fire-retardant treated wood must be pressure treated with fire retardants conforming to AWPA P49. Fire retardant treatment of wood products must conform to the requirements of AWPA U1, Commodity Specification H and

AWPA T1, Section H. Treatment and performance inspection must be by an independent and qualified testing agency that establishes performance ratings. Each piece or bundle of treated material must bear identification of the testing agency to indicate performance in accordance with such rating. Treated materials to be exposed to rain wetting must be subjected to an accelerated weathering technique in accordance with ASTM D2898 prior to being tested. Such items which will not be inside a building, and such items which will be exposed to heat or high humidity, must receive exterior fire-retardant treatment. Fire-retardant-treated wood products must be free of halogens, sulfates, ammonium phosphate, and formaldehyde. Items to be treated include the following:

- a. Plywood backer board.
- b. Roof edge blocking.

1.9 QUALITY ASSURANCE

1.9.1 Humidity Requirements

Sequence work to minimize use of temporary HVAC to dry out building and control humidity.

1.10 ENVIRONMENTAL REQUIREMENTS

During and immediately after installation of treated wood, engineered wood products, and laminated wood products at interior spaces, provide temporary ventilation.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Virgin Lumber

Lumber fabricated from old growth timber is not permitted. Avoid companies who buy, sell, or use old growth timber in their operations, when possible. Provide certified sustainably harvested virgin lumber.

2.2 LUMBER

2.2.1 Framing Lumber

Framing lumber such as studs, plates, caps, collar beams, cant strips, bucks, sleepers, nailing strips, and nailers and board lumber such as subflooring and wall and roof sheathing must be one of the species listed in the table below. Minimum grade of species must be as listed. Finger-jointed lumber may be used in the same applications as solid lumber of an equivalent species and grade, provided the finger-jointed lumber meets all the requirements of the certification and the quality control programs of the rules writing agency having jurisdiction and all applicable requirements of DOC/NIST PS56. Provide certified sustainably harvested framing lumber.

<u>Table of Grades for Framing and Board Lumber</u>			
<u>Grading Rules</u>	<u>Species</u>	<u>Framing</u>	<u>Board Lumber</u>
WWPA G-5 standard grading rules	Aspen, Douglas Fir-Larch, Douglas Fir South, Engelmann Spruce-Lodgepole Pine, Engelmann Spruce, Hem-Fir, Idaho White Pine, Lodgepole Pine, Mountain Hemlock, Mountain Hemlock-Hem-Fir, Ponderosa Pine-Sugar Pine, Ponderosa Pine-Lodgepole Pine, Subalpine Fir, White Woods, Western Woods, Western Cedars, Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: No. 3 Common
WCLIB 17 standard grading rules	Douglas Fir-Larch, Hem-Fir, Mountain Hemlock, Sitka Spruce, Western Cedars, Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: Standard

<u>Table of Grades for Framing and Board Lumber</u>			
<u>Grading Rules</u>	<u>Species</u>	<u>Framing</u>	<u>Board Lumber</u>
SPIB 1003 standard grading rules	Southern Pine	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	No. 2 Boards
SCMA Spec standard specifications	Cypress	No. 2 Common	No. 2 Common
NELMA Grading Rules standard grading rules	Balsam Fir, Eastern Hemlock-Tamarack, Eastern Spruce, Eastern White Pine, Northern Pine, Northern Pine-Cedar	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: No. 3 Common except Standard for Eastern White and Northern Pine
RIS Grade Use standard specifications	Redwood	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	Construction Heart

Table of Grades for Framing and Board Lumber			
Grading Rules	Species	Framing	Board Lumber
NHLA Rules rules for the measurement and inspection of hardwood and cypress lumber	Cypress	No. 2 Dimension	No. 2 Common

2.3 PLYWOOD, STRUCTURAL-USE, AND ORIENTED STRAND BOARD (OSB) PANELS

APA L870, APA S350, APA E445, and APA F405 respectively.

2.3.1 Other Uses

2.3.1.1 Plywood

C-D Grade, Exposure 1. Provide certified sustainably harvested plywood for other uses.

2.4 OTHER MATERIALS

2.4.1 Miscellaneous Wood Members

2.4.1.1 Nonstress Graded Members

Members must include bridging, corner bracing, furring, grounds, and nailing strips. Members must be in accordance with TABLE I for the species used. Sizes must be as follows unless otherwise shown:

Member	Size inch
Bridging	1 x 3 or 1 x 4 for use between members 2 x 12 and smaller; 2 x 4 for use between members larger than 2 x 12.
Corner bracing	1 x 4
Furring	1 x 2
Grounds	Plaster thickness by 38.
Nailing strips	1 x 3 or 1 x 4 when used as shingle base or interior finish, otherwise 2 inch stock.

2.4.1.2 Wood Bumpers

AREMA Eng Man, Industrial grade cross ties

2.4.1.3 Sill Plates

Sill plates must be standard or number 2 grade.

2.4.1.4 Blocking

Blocking must be standard or number 2 grade.

2.4.1.5 Rough Bucks and Frames

Rough bucks and frames must be straight standard or number 2 grade.

2.4.2 Adhesives

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of GS-36. Low-emitting requirements should comply with those listed in 07 92 00 for Adhesives.

2.5 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware must be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials must be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs must be hot-dip zinc-coated in accordance with ASTM A153/A153M. Nails and fastenings for fire-retardant treated lumber and woodwork exposed to the weather must be copper alloy or hot-dipped galvanized fasteners as recommended by the treated wood manufacturer.

2.5.1 Bolts, Nuts, Studs, and Rivets

ASME B18.2.1, ASME B18.5.2.1M, ASME B18.5.2.2M and ASME B18.2.2.

2.5.2 Anchor Bolts

ASTM A307, size as indicated, complete with nuts and washers.

2.5.3 Expansion Shields

CID A-A-1923, CID A-A-1924, and CID A-A-1925. Except as shown otherwise, maximum size of devices must be 3/8 inch.

2.5.4 Lag Screws and Lag Bolts

ASME B18.2.1.

2.5.5 Wood Screws

ASME B18.6.1.

2.5.6 Nails and Staples

ASTM F547, size and type best suited for purpose; staples must be as

recommended by the manufacturer of the materials to be joined. For sheathing and subflooring, length of nails must be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails must be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails must be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing must be hot-dipped galvanized in accordance with ASTM A153/A153M. Nailing must be in accordance with the recommended nailing schedule contained in AWC WFCM. Where detailed nailing requirements are not specified, nail size and spacing must be sufficient to develop an adequate strength for the connection. The connection's strength must be verified against the nail capacity tables in AWC NDS. Reasonable judgment backed by experience must ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector must be used.

2.5.7 Wire Nails

ASTM F1667.

2.5.8 Clip Angles

Steel, 3/16 inch thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

2.5.9 Joist Hangers

Steel or iron, zinc coated, sized to fit the supported member, of sufficient strength to develop the full strength of the supported member in accordance with ICC IBC, and furnished complete with any special nails required.

2.5.10 Tie Straps

For joists supported by the lower flange of steel beams, provide 1/8 by 1-1/2 inch steel strap, 2 feet long, except as indicated otherwise.

2.5.11 Joist Anchors

For joists supported by masonry walls, provide anchors 3/16 by 1 1/2 inch steel tee or strap, bent and of length to provide 4 inches embedment into wall and 12 inches along joist except as indicated otherwise. For joists parallel to masonry or concrete walls, provide anchors 1/4 by 1-1/4 inch minimum cross-sectional area, steel strap, length as necessary to extend over top of first three joists and into wall 4 inches, and with wall end of bend or pin type, except as indicated otherwise.

2.5.12 Door Buck Anchors

Metal anchors, 1/8 by 1-1/4 inch steel, 12 inches long, with ends bent 2 inches, except as indicated otherwise. Anchors must be screwed to the backs of bucks and built into masonry or concrete. Locate 8 inches above sills and below heads and not more than 24 inches intermediately between. Anchorage of bucks to steel framing must be as necessary to suit the conditions.

2.5.13 Metal Bridging

Where not indicated or specified otherwise, No. 16 U.S. Standard gage,

cadmium-plated or zinc-coated.

2.5.14 Toothed Rings and Shear Plates

AWC NDS.

2.5.15 Beam Anchors

Steel U-shaped strap anchors 1/4 inch thick by 1-1/2 inches wide, except as indicated otherwise.

2.5.16 Metal Framing Anchors

Construct anchors to the configuration shown using hot dip zinc-coated steel conforming to ASTM A653/A653M, G90. Except where otherwise shown, Steel must be not lighter than 18 gage. Special nails supplied by the manufacturer must be used for all nailing.

2.5.17 Panel Edge Clips

Extruded aluminum or galvanized steel, H-shaped clips to prevent differential deflection of roof sheathing.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Conform to AWC WFCM and install in accordance with the National Association of Home Builders (NAHB) Advanced Framing Techniques: Optimum Value Engineering, unless otherwise indicated or specified. Select lumber sizes to minimize waste. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Do not splice framing members between bearing points. Set joists, rafters, and purlins with their crown edge up. Frame members for the passage of pipes, conduits, and ducts. Provide adequate support as appropriate to the application, climate, and modulus of elasticity of the product. Do not cut or bore structural members for the passage of ducts or pipes without approval. Reinforce all members damaged by such cutting or boring by means of specially formed and approved sheet metal or bar steel shapes, or remove and provide new, as approved. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spiking and nailing not indicated or specified otherwise must be in accordance with the Nailing Schedule contained in ICC IBC; perform bolting in an approved manner. Spikes, nails, and bolts must be drawn up tight. Use slate or steel shims when leveling joists, beams, and girders on masonry or concrete. Do not use shimming on wood or metal bearings. When joists, beams, and girders are placed on masonry or concrete, a wood base plate must be positioned and leveled with grout. The joist, beam, or girder must then be placed on the plate. When joists, beams, and girders are set into masonry or concrete, a pocket must be formed into the wall. The joist, beam, or girder must then be placed into the pocket and leveled with a steel shim.

3.1.1 Sills

Set sills level and square and wedge with steel or slate shims; point or

grout with non-shrinking cement mortar to provide continuous and solid bearing. Anchor sills to the foundations as indicated. Where sizes and spacing of anchor bolts are not indicated, provide not less than 5/8 inch diameter bolts at all corners and splices and space at a maximum of 6 feet o.c. between corner bolts. Provide at least two bolts for each sill member. Lap and splice sills at corners and bolt through the laps or butt the ends and through-bolt not more than 6 inches from the ends. Provide bolts with plate washers and nuts. Bolts in exterior walls must be zinc-coated.

3.1.1.1 Anchors in Masonry

Except where indicated otherwise, Embed anchor bolts not less than 15 inches in masonry unit walls and provide each with a nut and a 2 inch diameter washer at bottom end. Fully grout bolts with mortar.

3.1.1.2 Anchors in Concrete

Except where indicated otherwise, Embed anchor bolts not less than 8 inches in poured concrete walls and provide each with a nut and a 2 inch diameter washer at bottom end. A bent end may be substituted for the nut and washer; bend must be not less than 90 degrees. Powder-actuated fasteners spaced 3 feet o.c. may be provided in lieu of bolts for single thickness plates on concrete.

3.2 MISCELLANEOUS

3.2.1 Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

3.2.1.1 Roof Edge Strips and Nailers

Provide at perimeter of roof, around openings through roof, and where roofs abut walls, curbs, and other vertical surfaces. Except where indicated otherwise, nailers must be 6 inches wide and the same thickness as the insulation. Anchor nailers securely to underlying construction. Anchor perimeter nailers in accordance with FM 4435.

3.2.1.2 Crickets, Cants, and Curbs

Provide wood saddles or crickets, cant strips, curbs for scuttles and ventilators, and wood nailers bolted to tops of concrete or masonry curbs as indicated, specified, or necessary and of lumber.

3.2.2 Rough Wood Bucks

2 inch nominal thickness. Set wood bucks true and plumb. Anchor bucks to concrete or masonry with steel straps extending into the wall 8 inches minimum. Place anchors near the top and bottom of the buck and space uniformly at 2 foot maximum intervals.

3.2.3 Wood Blocking

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

3.2.4 Wood Grounds

Provide for fastening wood trim, finish materials, and other items to plastered walls and ceilings. Install grounds in proper alignment and true with an 8 foot straightedge.

3.2.5 Wood Furring

Provide where shown and as necessary for facing materials specified. Except as shown otherwise, furring strips must be nominal one by 3, continuous, and spaced 16 inches o.c. Erect furring vertically or horizontally as necessary. Nail furring strips to masonry. Do not use wood plugs. Provide furring strips around openings, behind bases, and at angles and corners. Furring must be plumb, rigid, and level and must be shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required. Form furring for offsets and breaks in walls or ceilings on 1 by 4 wood strips spaced 16 inches o.c.

3.2.6 Wood Bumpers

Dress to the sizes indicated, and bevel edges. Bore, countersink, and bolt bumpers in place.

3.2.7 Temporary Closures

Provide with hinged doors and padlocks and install during construction at exterior doorways and other ground level openings that are not otherwise closed. Cover windows and other unprotected openings with polyethylene or other approved material, stretched on wood frames. Provide dustproof barrier partitions to isolate areas as directed.

3.2.8 Temporary Centering, Bracing, and Shoring

Provide for the support and protection of masonry work during construction as specified in Section 04 20 00. Forms and centering for cast-in-place concrete work are specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.2.9 Wood Sleepers

Run wood sleepers in lengths as long as practicable and stagger end joints in adjacent rows.

3.2.10 Sill Plates

Sill plates must be set level and square and anchor bolted at not more than 6 feet on centers and not more than 12 inches from end of each piece. A minimum of two anchors must be used for each piece.

3.3 ERECTION TOLERANCES

- a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, must be within the following limits:

- (1) Layout of walls and partitions: 1/4 inch from intended position;
- (2) Plates and runners: 1/4 inch in 8 feet from a straight line;
- (3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/4 inch in 8 feet from a true plane.

- b. Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive must be within the following limits:

(1) Layout of walls and partitions: 1/4 inch from intended position;

(2) Plates and runners: 1/8 inch in 8 feet from a straight line;

(3) Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/8 in 8 feet from a true plane.

3.4 WASTE MANAGEMENT OF WOOD PRODUCTS

In accordance with the Waste Management Plan and as specified. Separate and reuse scrap sheet materials larger than 2 square feet, framing members larger than 16 inches, and multiple offcuts of any size larger than 12 inches. Clearly separate damaged wood and other scrap lumber for acceptable alternative uses on site, including bracing, blocking, cripples, ties, and shims.

Separate composite wood from other wood types and recycle or reuse. Fold up metal banding, flatten, and recycle.

Separate treated, stained, painted, and contaminated wood and place in designated area for hazardous materials. Dispose of according to local regulations. Do not leave any wood, shavings, sawdust, or other wood waste buried in fill or on the ground. Prevent sawdust and wood shavings from entering the storm drainage system. Compost sawdust. Do not burn scrap lumber that has been pressure treated, or lumber that is less than one year old.

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SECTION 06 13 33

PIER TIMBERWORK
11/16, CHG 1: 08/17

PART 1 GENERAL

1.1 Introduction

This section applies to misc timberwork used on the pier to include:

- a. Timber Chocks and Blocks for the fender system.
- b. Timber bullrail and blocks.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA A3	(2015) Standard Method for Determining Penetration of Preservatives and Fire Retardants
AWPA M4	(2021) Standard for the Care of Preservative-Treated Wood Products
AWPA M6	(2018) Brands Used on Preservative Treated Materials
AWPA P5	(2015) Standard for Waterborne Preservatives
AWPA P34	(2020) Standard for Copper Naphthenate, Waterborne (CuN-W)
AWPA T1	(2021) Use Category System: Processing and Treatment Standard
AWPA U1	(2021) Use Category System: User Specification for Treated Wood

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60

000 PSI Tensile Strength

ASTM D5643/D5643M

(2012) Standard Specification for Coal Tar
Roof Cement, Asbestos Free

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-P-21035

(1991; Rev B; Notice 2 2003; Notice 3
2021) Paint, High Zinc Dust Content,
Galvanizing Repair (Metric)

WESTERN WOOD PRESERVERS INSTITUTE (WWPI)

WWPI Mgt Practices

(1996; R 2011) Best Management Practices
for the Use of Treated Wood in Aquatic and
Wetland Environments

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pier Timberwork; G

Submit drawings of treated timber showing dimensions of cut, framed, or bored timbers.

SD-06 Test Reports

Preservative Treatment - Pier Timberworks; G

The Contractor must provide the Contracting Officer's Representative (COR) with the inspection report of an independent inspection agency, approved by the Contracting Officer, that offered products comply with applicable AWP standards.

Delivery Inspection List; G

SD-07 Certificates

SDS and CIS; G

Pesticide Applicator Company Self-Certification; G

Best Management Practices (BMPs); G

1.4 DELIVERY, STORAGE, AND HANDLING

Handle and store piles in accordance with AWP M4. Follow precautions identified in SDS and CIS provided by the supplier of treated wood products.

Open-stack untreated timber and lumber material on skids at least 12 inches above ground, in a manner that will prevent warping and allow shedding of water. Close-stack treated timber and lumber material in a manner that

will prevent long timbers or preframed material from sagging or becoming crooked. Keep ground under and within 5 feet of such piles free of weeds, rubbish, and combustible materials. Protect materials from weather. Handle treated timber with ropes or chain slings without dropping, breaking outer fibers, bruising, or penetrating surface with tools. Do not use cant dogs, peaveys, hooks, or pike poles. Protect timber and hardware from damage.

1.5 QUALITY ASSURANCE

1.5.1 Preservative Treatment - Pier Timberworks

The Contractor must be responsible for the quality of treated wood products. The Contractor must provide the Contracting Officer's Representative (COR) with the inspection report of an independent inspection agency, approved by the Contracting Officer, certifying that the offered products comply with applicable AWPA standards. Identify treatment on each piece by the quality mark of an agency accredited by the Board of Review of the American Lumber Standard Committee. Inspect all preservative-treated wood visually to ensure there are no excessive residual materials or preservative deposits. Material must be clean and dry or it will be rejected because of environmental concerns.

1.5.2 SDS and CIS

Provide Safety Data Sheets (SDS) and Consumer Information Sheets (CIS) associated with timber pile preservative treatment. Contractor must comply with all safety precautions indicated on SDS and CIS.

1.5.3 Delivery Inspection List

Field inspect and submit a verification list of each treated timber member and each strapped bundle of treated lumber indicating the wording and lettering of the quality control markings, the species and the condition of the wood. Do not incorporate materials damaged in transport from plant to site. Inspect all preservative-treated wood, visually to ensure there are no excessive residual materials or preservative deposits. Material must be clean and dry or it will be rejected due to environmental concerns.

1.5.4 Pesticide Applicator Company Self-Certification

Provide the Contracting Officer, a statement signed by the responsible site supervisor or higher company representative, certifying that the contractor will comply with all pesticide label instructions. The certification should identify by name all individuals (applicators) who will be working with wood preserving pesticide products on site.

1.5.5 Best Management Practices (BMPs)

The producer of the treated wood products must provide certification that WWPI Mgt Practices for the use of Treated Wood in Aquatic and Wetland Environments were utilized including a written description and appropriate documentation of the BMPs utilized.

As part of the BMPs for CCA treated pier timberwork, certification must be provided that documents that the Chromotropic Acid Test (AWPA A3- Methods for Determination of the Presence of Hexavalent Chromium in Treated Wood) was performed on the timber and adequate fixation of the CCA treatment has been achieved prior to installation.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Lumber and Timbers

Provide solid sawn lumber and timbers of stress-rated Southern Pine, Douglas Fir-Larch, or Red Pine, and identified by the grade mark of a recognized association or independent inspection agency using the specific grading requirements of an association recognized as covering the species used. The association or independent inspection agency must be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. For secondary members use lumber or timbers rated No. 1 or better.

2.1.2 Preservative Treatment

Fabricate lumber and timbers before preservative treatment. Each piece of treated lumber or timber must be branded, by the producer, in accordance with AWPA M6. The type of preservative, retention, and penetration must be based on Use Category and species and in accordance with AWPA U1 and AWPA T1. The Contractor must be responsible for the quality of treated wood products.

For wood in contact with brackish water, salt water, or saltwater splash, lumber and timber preservative treatment must be Waterborne preservative in accordance with AWPA P5 CCA - Chromated Copper Arsenate.

For wood not in contact with brackish water, salt water, or salt water splash, treatment must be in accordance with AWPA U1 Commodity Specification A: Sawn Products with water-borne preservative (AWPA P5) except that chromated zinc chlorides, pentachlorophenol-ammoniacal systems, and alkyl ammonium compounds will not be allowed.

2.1.3 Field Treatment

All cuts, holes and injuries such as holes from removal of spikes or nails which may penetrate the treated zone must be field treated with copper naphthenate conforming to AWPA P34 and coal-tar roofing cement conforming to ASTM D5643/D5643M.

2.1.4 Hardware

Pile hardware must consist of bolts with necessary nuts and washers, timber connectors, timber bolts, nails, screws, spikes, and other fastenings. Bolts and nuts must conform to ASTM A307. Provide cast-iron ogee, malleable iron washers, or plate or cut washers where indicated. Provide bolts with washers under nut and head. Provide timber bolts with washers under nut. Provide timber connectors and other metal fastenings of type and size indicated. Hot-dip galvanize all hardware specified or indicated in accordance with ASTM A123/A123M or ASTM A153/A153M, as applicable.

PART 3 EXECUTION

3.1 INSTALLATION

Cut, bevel, and face timbers prior to plant preservative treatment. In

addition to the contract clause entitled "Accident Prevention" provide protective equipment for personnel fabricating, field treating, or handling materials treated with water-borne salts. Refer to paragraph SDS AND CIS.

3.1.1 Framing

Cut and frame lumber and timber so that joints will fit over contact surface. Secure timbers alignment. Open joints are unacceptable. Drill holes for bolts with a bit 1/16 inch larger in diameter than rod or bolt. Drill holes for lag screws in two parts. Make lead hole for shank the same diameter as shank. Make lead hole for the threaded portion approximately two-thirds of the shank diameter. Drill holes in small timbers for boat or wire spikes with a bit of the same diameter or smallest dimension of the spike to prevent splitting.

3.1.2 Fender Systems

Face HDPE Jacket to receive chocks. Use only full-length timbers for chocks and tightly fit against steel fender piles. Splice wales in location in a as indicated. Additional splicing of wales will not be permitted.

3.1.3 Fastening

Vertical bolts must have nuts on the lower end. Where bolts are used to fasten timber to timber, timber to concrete, or timber to steel, bolt members together when they are installed and retighten immediately prior to final acceptance of contract. Provide bolts having sufficient additional threading to provide at least 3/8 inch per foot thickness of timber for future retightening.

3.2 FIELD TREATMENT

3.2.1 Pier timberwork

Field treat all cuts, holes, bevels, notches, refacing, abrasions, and injuries such as abrasions or holes from removal of spikes or nails made in the field in treated piles or timbers in accordance with AWPA M4, SDS and CIS. Trim cuts and abrasions before field treatment. Depressions or openings around bolt holes, joints, or gaps including recesses formed by counterboring must be field treated with copper naphthenate conforming to AWPA P34; and after bolt or screw is in place, fill with coal-tar roofing cement conforming to ASTM D5643/D5643M.

3.2.2 Galvanized Surfaces

Repair and recoat zinc coating which has been field or shop cut, burned by welding, abraded, or otherwise damaged to such an extent as to expose the base metal. Thoroughly clean the damaged area by wire brushing and remove traces of welding flux and loose or cracked zinc coating prior to painting. Paint cleaned area with two coats of zinc oxide-zinc dust paint conforming to MIL-P-21035. Compound paint with a suitable vehicle in a ratio of one part zinc oxide to four parts zinc dust by weight.

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SECTION 06 41 16.00 10

PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS
08/10, CHG 1: 11/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A161.2 (1998) Decorative Laminate Countertops,
Performance Standards for Fabricated High
Pressure

ASTM INTERNATIONAL (ASTM)

ASTM F547 (2017) Standard Terminology of Nails for
Use with Wood and Wood-Base Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.9 (2015) Cabinet Hardware

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3 (2005) Standard for High-Pressure
Decorative Laminates

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

UL ENVIRONMENT (ULE)

ULE Greenguard UL Greenguard Certification Program

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

ANSI/WDMA I.S.1A (2013) Interior Architectural Wood Flush
Doors

WOODWORK INSTITUTE (WI)

NAAWS 3.1 (2017; 2018 Errata Edition) North American
Architectural Woodwork Standards

1.2 SYSTEM DESCRIPTION

Work in this section includes laminate clad custom casework cabinets and display cases as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. Comply with EPA requirements in accordance with Section

01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane. Wood finish may be shop finished or field applied in accordance with Section 09 90 00 PAINTS AND COATINGS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G

Installation

SD-03 Product Data

Wood Materials

Finish Schedule

SD-04 Samples

Plastic Laminates; G

Cabinet Hardware

SD-07 Certificates

Quality Assurance

Laminate Clad Casework

EPD(s); S

Recycled Content; S

Forest Stewardship Council (FSC) Certification; S

Regional Material; S

VOC Emissions; S

Formaldehyde Emissions; S

Legal Wood; S

1.3.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this

product has an EPD complying with LEED v4.1 requirements.

1.3.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for applicable products.

Provide Forest Stewardship Council (FSC) certification for wood products.

Provide regional material certifications for all materials that apply.

1.3.1.3 IEQ Low Emitting Materials:

For finishes applied inside the weatherproofing system - submit VOC statement indicating compliance with the;

a. VOC Emissions Evaluation.

For Composite Wood applied inside the weatherproofing system - submit statement indicating compliance with the;

a. Formaldehyde Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.3.1.4 Legal Wood

Submit product data verifying product is from Legal and Responsible Sources per ASTM D7612-10 as required to achieve LEED credit.

1.4 QUALITY ASSURANCE

1.4.1 General Requirements

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the premium or custom grade quality standards as outlined in NAAWS 3.1, Section for laminate clad cabinets. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Submit a quality control statement which illustrates compliance with and understanding of NAAWS 3.1 requirements, in general, and the specific NAAWS 3.1 requirements provided in this specification. The quality control statement shall also certify a minimum of ten years Contractor's experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

1.4.2 Sustainable Design Certification

Product shall be third party certified in accordance with ULE Greenguard Gold, SCS Scientific Certification Systems Indoor Advantage Gold or equal. Certification shall be performed annually and shall be current.

1.5 DELIVERY, STORAGE, AND HANDLING

Casework may be delivered knockdown or fully assembled. Deliver all units

to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

1.6 SEQUENCING AND SCHEDULING

Coordinate work with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 Lumber

- a. All framing lumber shall be kiln-dried Grade III to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 3/4 inch hardwood.

2.1.2 Panel Products

2.1.2.1 Plywood

All plywood panels used for framing purposes shall be veneer core hardwood plywood, NAAWS 3.1 Grade AA. Nominal thickness of plywood panels shall be as indicated in this specification and on the drawings.

2.2 SOLID POLYMER MATERIAL

Solid surfacing casework components shall conform to the requirements of Section 06 61 16 SOLID SURFACING FABRICATIONS.

2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of ANSI/NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings. Submit two samples of each plastic laminate pattern and color. Samples shall be a minimum of 5 by 7 inches in size. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

2.3.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 0.048 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.

2.3.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

2.3.3 Cabinet Liner Standard (CLS) Grade

Cabinet liner standard grade plastic laminate shall be 0.020 inches in thickness. This laminate grade is intended for light duty semi-exposed interior surfaces of casework components.

2.3.4 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.020 inches. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

2.4 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Thermoset decorative overlays (melamine panels) shall be used for surfaces indicated on drawings.

2.5 EDGE BANDING

Edge banding for casework doors and drawer fronts shall be PVC vinyl and shall be 0.125 inch thick. Material width shall be as indicated on the drawings. Color and pattern shall match exposed door and drawer front laminate pattern and color.

2.6 CABINET HARDWARE

All hardware shall conform to ANSI/BHMA A156.9, unless otherwise noted, and shall consist of the following components:

2.6.1 Door Hinges

Heavy duty concealed type, BHMA No. B01602.

2.6.2 Cabinet Pulls

Tab drawer pull with 1.5 inch profile and 3 inch wide, equal to model No. DP3A as manufactured by Doug Mockett and Company. Finish: Polished Chrome.

2.6.3 Drawer Slide

Side mounted type, BHMA No. B05091 with full extension and a minimum 75 pound load capacity. Slides shall include an integral stop to avoid accidental drawer removal.

2.6.4 Adjustable Shelf Support System

Recessed (mortised) metal standards, BHMA No. B04071, finish: 626. Support clips for the standards shall be closed type, BHMA No. B04081, finish: 626.

2.7 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F547 where applicable.

2.8 ADHESIVES, CAULKS, AND SEALANTS

2.8.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing.

2.8.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use polyvinyl acetate resin emulsion. Adhesives shall withstand a bond test as described in ANSI/WDMA I.S.1A.

2.8.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be adhesive consistent with AWI and laminate manufacturer's recommendations. PVC edgbanding shall be adhered using a polymer-based hot melt glue.

2.8.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

2.8.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture.

2.9 FABRICATION

Verify field measurements as indicated in the shop drawings before fabrication. Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI premium custom grade unless otherwise indicated in this specification. Cabinet style, in accordance with NAAWS 3.1, Section 400-G descriptions, shall be as indicated on the drawings.

2.9.1 Base and Wall Cabinet Case Body

2.9.1.1 Cabinet Components

Frame members shall be glued-together, kiln-dried hardwood lumber. Top corners, bottom corners, and cabinet bottoms shall be braced with either hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Cabinet components shall be constructed from the following materials and thicknesses:

2.9.1.1.1 Body Members (Ends, Divisions, Bottoms, and Tops)

3/4 inch medium density fiberboard (MDF) panel product

2.9.1.1.2 Face Frames and Rails

3/4 inch hardwood lumber or panel product

2.9.1.1.3 Shelving

3/4 inch medium density fiberboard (MDF) panel product

2.9.1.1.4 Cabinet Backs

1/4 inch medium density fiberboard (MDF) panel product

2.9.1.1.5 Drawer Sides, Backs, and Subfronts

1/2 inch hardwood lumber or panel product

2.9.1.1.6 Drawer Bottoms

1/4 inch medium density fiberboard (MDF) panel product

2.9.1.1.7 Door and Drawer Fronts

3/4-inch medium density fiberboard (MDF) panel product

2.9.1.2 Joinery Method for Case Body Members

2.9.1.2.1 Tops, Exposed Ends, and Bottoms

- a. Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts).
- b. Spline or biscuit, glued under pressure.

2.9.1.2.2 Exposed End Corner and Face Frame Attachment

2.9.1.2.2.1 Non-Mitered Joint (90 degree)

butt joint glued under pressure (no visible fasteners)

2.9.1.2.3 Cabinet Backs (Wall Hung Cabinets)

Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members. Fabrication method shall be:

2.9.1.2.3.1 Side Bound

Side bound, captured in groove or rabbetts; glued and fastened.

2.9.1.2.4 Cabinet Backs (Floor Standing Cabinets)

2.9.1.2.4.1 Side Bound

Side bound, captured in grooves; glued and fastened to top and bottom.

2.9.2 Cabinet Floor Base

Floor cabinets shall be mounted on a base constructed of 3/4 inch fiberboard. Base assembly components shall be a moisture-resistant panel product. Finished height for each cabinet base shall be as indicated on the drawings. Bottom edge of the cabinet door or drawer face shall as indicated on the drawings.

2.9.3 Cabinet Door and Drawer Fronts

Door and drawer fronts shall be fabricated from 3/4 inch medium density fiberboard (MDF). All door and drawer front edges shall be surfaced with high pressure plastic laminate, color and pattern to match exterior face laminate.

2.9.4 Drawer Assembly

2.9.4.1 Drawer Components

Drawer components shall consist of a removable drawer front, sides, backs, and bottom. Drawer components shall be constructed of the following materials and thicknesses:

2.9.4.1.1 Drawer Sides and Back For Thermoset Decorative Overlay (Melamine) Finish

1/2 inch thick MDF fiberboard substrate

2.9.4.1.2 Drawer Bottom

1/4 inch thick plastic laminate finish or thermoset decorative overlay melamine panel product

2.9.4.2 Drawer Assembly Joinery Method

- a. Multiple dovetail (all corners) or French dovetail front/dadoed back, glued under pressure.

2.9.5 Shelving

2.9.5.1 General Requirements

Shelving shall be fabricated from 3/4 inch medium density particleboard. All shelving top and bottom surfaces shall be finished with HPDL plastic laminate or thermoset decorative overlay (melamine). Shelf edges shall be finished in a HPDL plastic laminate or thermoset decorative overlay (melamine).

2.9.5.2 Shelf Support System

The shelf support system shall be:

2.9.5.2.1 Recessed (Mortised) Metal Shelf Standards

Mortise standards flush with the finishes surface of the cabinet interior side walls, two per side. Position and space standards on the side walls to provide a stable shelf surface that eliminates tipping when shelf front is weighted. Install and adjust standards vertically to provide a level, stable shelf surface when clips are in place.

2.9.6 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and ANSI/NEMA LD 3, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to ANSI A161.2. Laminate types and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

2.9.6.1 Base/Wall Cabinet Case Body

- a. Exterior (exposed) surfaces to include exposed and semi-exposed face frame surfaces: HPDL Grade VGS.
- b. Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: HPDL Grade CLS or Thermoset Decorative Overlay (melamine).

2.9.6.2 Adjustable Shelving

2.9.6.2.1 Top and Bottom Surfaces

HPDL Grade HGS

2.9.6.2.2 All Edges

HPDL Grade VGS

2.9.6.3 Fixed Shelving

2.9.6.3.1 Top and Bottom Surfaces

HPDL Grade HGS

2.9.6.3.2 Exposed Edges

HPDL Grade VGS or PVC edgebanding

2.9.6.4 Door, Drawer Fronts, Access Panels

2.9.6.4.1 Exterior (Exposed) and Interior (Semi-Exposed) Faces

HPDL Grade VGS or VGP

2.9.6.4.2 Edges

HPDL Grade VGS or PVC edgebanding

2.9.6.5 Drawer Assembly

All interior and exterior surfaces: HPDL Grade CLS or Thermoset Decorative Overlay (melamine).

2.9.6.6 Countertops and Splashes

All exposed and semi-exposed surfaces: HPDL Grade HGS

2.9.6.7 Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the NAAWS 3.1 custom grade requirements.

2.9.7 Finishing

2.9.7.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

2.9.7.2 Sanding

All surfaces requiring coatings shall be prepared by sanding with a grit and in a manner that scratches will not show in the final system.

2.9.7.3 Coatings

Types, method of application and location of casework finishes shall be in accordance with the finish schedule, drawings and Section 09 90 00 PAINTS AND COATINGS. All cabinet reveals shall be painted. Submit descriptive data which provides narrative written verification of all types of construction materials and finishes, methods of construction, etc. not clearly illustrated on the submitted shop drawings. Data shall provide written verification of conformance with NAAWS 3.1 for the quality indicated to include materials, tolerances, and types of construction. Both the manufacturer of materials and the fabricator shall submit available literature which describes re-cycled product content, operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall comply with applicable requirements for NAAWS 3.1 custom quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1 Anchoring Systems

3.1.1.1 Floor

Base cabinets shall utilize a floor anchoring system. Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Cabinet assemblies shall be attached to anchored bases without visible fasteners. Where assembly abuts a wall surface, anchoring shall include a minimum 1/2 inch thick lumber or panel product hanging strip, minimum 2-1/2 inch width; securely attached to the top of the wall side of the cabinet back.

3.1.1.2 Wall

Cabinet to be wall mounted shall utilize minimum 1/2 inch thick lumber or panel product hanging strips, minimum 2-1/2 inch width; securely attached to the wall side of the cabinet back, both top and bottom.

3.1.2 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with fiberboard doors, the use of plastic or synthetic insertion dowels shall be used to receive 3/16 inch "Euro screws". The use of wood screws without insertion dowels is prohibited.

3.1.3 Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished within target fitting tolerances for gaps and flushness in accordance with NAAWS 3.1 custom grade requirements.

3.1.4 Plumbing Fixtures

Install sinks, sink hardware, and other plumbing fixtures in locations as indicated on the drawings.

-- End of Section --

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SECTION 06 61 16

SOLID SURFACING FABRICATIONS
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D2583	(2013a) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G21	(2015) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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INTERNATIONAL CAST POLYMER ASSOCIATION (ICPA)

ICPA SS-1	(2001) Performance Standard for Solid Surface Materials
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3 (2005) Standard for High-Pressure
Decorative Laminates

NSF INTERNATIONAL (NSF)

NSF/ANSI 51 (2012) Food Equipment Materials

1.2 SYSTEM DESCRIPTION

- a. Work under this section includes countertops and window stools and other items utilizing solid surfacing material fabrications as indicated on the drawings and as described in this specification. Do not change source of supply for materials after work has started, if the appearance of finished work would be affected.
- b. In most instances, installation of solid surfacing material fabricated components and assemblies requires strong correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid surfacing material fabricator/installer and other trades to ensure that necessary structural wall support, cabinet counter top structural support, proper clearances, and other supporting components are provided for the installation of wall panels, counter tops, shelving, and all other solid surfacing material fabrications to the degree and extent recommended by the solid surfacing material manufacturer.
- c. Provide appropriate staging areas for solid surfacing material fabrications. Allow variation in component size and location of openings of plus or minus 1/8 inch.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Fabrication Drawings; G

Installation

SD-03 Product Data

Solid Polymer; G

Indoor air quality for solid surface seam and sealant products; S

SD-04 Samples

Material; G

SD-06 Test Reports

Test Report Results

SD-07 Certificates

Qualifications

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

Indoor Air Quality for solid surface fabrication products; S

SD-10 Operation and Maintenance Data

Solid Polymer, Data Package 1; G

1.3.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for applicable products.

Provide regional material certifications for all materials that apply.

1.3.1.3 IEQ Low-Emitting Materials:

For window sills applied inside the weatherproofing system - submit VOC statement indicating compliance with the;

a. VOC Emissions Evaluation.

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

To ensure warranty coverage, provide manufacturer certified solid surfacing fabricators to fabricate the solid surfacing material being utilized. Mark all fabrications with the fabricator's certification label affixed in an inconspicuous location. Minimum of 5 years of experience working with solid surfacing materials is required of fabricators. Submit solid surfacing material manufacturer's certification attesting to fabricator qualification approval.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver materials to project site until areas are ready for installation. Deliver components and materials to the site undamaged, in containers clearly marked and labeled with manufacturer's name. Store materials indoors and take adequate precautions to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation, for duration of project.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials.

1.7 Detail Drawings

Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices and other components.

Show full-size details, edge details, thermoforming requirements, attachments, etc.

Show locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.

Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste receptacle and other items installed in solid surface.

PART 2 PRODUCTS

2.1 MATERIAL

Submit detail fabrication drawings and installation drawings of each solid surfacing fabrication indicated. Include elevations, dimensions, clearances, details of construction and anchorage, and details of joints and connections.

Submit manufacturers' descriptive product data for each type of solid polymer fabrication indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

2.1.1 Solid Surfacing Material, SSF-1

Provide solid polymer material that is a homogeneous filled solid polymer; not coated, laminated or of a composite construction, complying with ICPA SS-1. Provide material that meets or exceeds the minimum physical and performance properties specified. Superficial damage to a depth of 0.01 inch must be repairable by sanding or polishing. Material thickness is as indicated on the drawings; required minimum thickness is 1.4 inch. Submit a minimum 4 inch by 4 inch sample of each color and pattern for approval; include full range of color and pattern variation. Retain approved samples as a standard for this work. Submit test report results from an independent testing laboratory attesting that the submitted solid surfacing materials meet or exceed each of the specified performance requirements.

- a. Provide materials that meet the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Provide certification or validation

of indoor air quality for solid surface fabrication products.

2.1.2 Cast, 100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material composed of acrylic polymer, mineral fillers, and pigments. Provide acrylic polymer that meets or exceeds the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	4000 psi (max.)	ASTM D638
Hardness	55-Barcol Impressor (min.)	ASTM D2583
Thermal Expansion	.000023 in/in/F (max.)	ASTM D696
Boiling Water Surface Resistance	No Change	ANSI/NEMA LD 3-3.05
High Temperature Resistance	No Change	ANSI/NEMA LD 3-3.06
Impact Resistance (Ball drop)		ANSI/NEMA LD 3-303
1/4 inch sheet	36-inches, 1/2 lb ball, no failure	
1/2 inch sheet	140-inches, 1/2 lb ball, no failure	
3/4 inch sheet	200-inches, 1/2 lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G21
Bacteria Growth	No growth	ASTM G21
Liquid Absorption (Weight in 24 hrs.)	0.1 percent max.	ASTM D570
Flammability		ASTM E84
Flame Spread	25 max.	
Smoke Developed	30 max.	
Sanitation	"Food Contact" approval	NSF/ANSI 51
Flexural Strength	6,800 psi (min.)	ASTM D790

2.1.3 Material Patterns and Colors

Provide pattern and color for all solid surfacing material components and fabrications as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers. Provide products with

consistent patterned color throughout thickness of the product.

2.1.4 Surface Finish

Provide a uniform appearance on exposed finished surfaces and edges.
Exposed surface finish is matte; gloss rating of 5-20.

2.2 ACCESSORY PRODUCTS

Provide accessory products, as specified below, as manufactured by the solid surfacing material manufacturer or as approved by the solid surfacing material manufacturer for use with the solid surfacing materials being specified.

2.2.1 Adhesives

Provide a two-part seam adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid surfacing materials and components to create a monolithic appearance of the fabrication. Provide adhesive approved by the solid surfacing material manufacturer. Color-match adhesive to the surfaces being bonded where solid-colored, solid surfacing materials are being bonded together. Provide clear or color matched seam adhesive where particulate patterned, solid surfacing materials are being bonded together.

2.2.2 Seam and Sealant Emissions

Provide seam and other accessory materials that meet the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Provide validation of indoor air quality for solid surface seam and sealant products.

2.2.3 Silicone Sealant

Provide silicone sealant, mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, acid-curing; ASTM C920, Type S, Grade NS, Class 25, Use NT; clear formulation; approved for use by the solid surfacing material manufacturer.

2.2.4 Mounting Hardware

Provide mounting hardware, including sink/bowl clips, inserts and fasteners for attachment of undermount sinks and lavatories.

2.3 FABRICATIONS

Provide factory or shop fabricate components to sizes and shapes indicated, to the greatest extent practical, in accordance with approved Shop Drawings and manufacturer's requirements. Provide factory cutouts for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii must be routed to template, with edges smooth. Defective and inaccurate work will be rejected. Submit product data indicating product description, fabrication information, and compliance with specified performance requirements for solid surfacing material, joint adhesive, and sealants.

2.3.1 Joints and Seams

Form joints and seams between solid surfacing material components using

manufacturer's approved seam adhesive. Provide inconspicuous joints in appearance without voids to create a monolithic appearance.

2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish. Provide edge shapes and treatments, including any inserts, as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

2.3.3 Counter Top Splashes

Fabricate backsplashes and end splashes from 1/2 inch thick solid surfacing material to be in conformance with dimensions and shapes as indicated. Provide backsplashes and end splashes at locations indicated. Shop fabricate backsplashes and provide loose, to be field attached.

2.3.3.1 End Splashes

Provide end splashes loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

2.3.4 Window Stools

Fabricate window stools from 1/2 inch thick solid surfacing material; dimensions, edge shape, and other details as indicated in drawings. Equal to the width of the window opening by a 1/2 inch overhang of the window sill depth. Provide edge profile indicated in drawings.

2.3.5 Counter Tops

Fabricate all solid surfacing material, counter top components from 1/2 inch thick material. Indicate details, dimensions, locations, and quantities on the drawings. Attach 2 inch wide reinforcing strip of solid surfacing material under each horizontal counter top seam. Submit a minimum 1 foot wide by 6 inch deep, full size sample for each type of counter top shown on the project drawings; include the edge profile and backsplash as detailed on the drawings and at least one seam. Retain approved sample as standard for this work. Provide bullnose edge profile.

2.3.5.1 Counter Tops with Sinks

- a. Provide stainless steel sink; include cutouts to template for counter tops with sinks as furnished by the sink manufacturer. Provide manufacturer's standard sink mounting hardware for sink type as indicated in 22 00 00 PLUMBING, GENERAL PURPOSE. Seal between sink and counter top with specified silicone sealant. Provide sink, faucet, and plumbing requirements in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Components

Install all components and fabricated units plumb, level, and rigid. Make field joints between solid surfacing material components using solid surfacing material manufacturer's approved seam adhesives, to provide a

monolithic appearance with joints inconspicuous in the finished work. Attach metal or vitreous china sinks and lavatory bowls to counter tops using solid surfacing material manufacturer's recommended clear silicone sealant and mounting hardware. Install solid polymer sinks and bowls using a color-matched seam adhesive.

3.1.1.1 Loose Counter Top Splashes

Mount loose splashes in the locations noted on the drawings. Adhere loose splashes to the counter top with a color matched silicone sealant when the solid surfacing material components are solid colors. Use a clear silicone sealant to provide adhesion of particulate patterned solid surfacing material splashes to counter tops.

3.1.2 Silicone Sealant

Use specified silicone sealant to seal all expansion joints between solid surfacing material components and all joints between solid surfacing material components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Provide sealant bead smooth and uniform in appearance and minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Provide continuous bead and run the entire length of the joint being sealed.

3.1.3 Plumbing

Make plumbing connections to sinks and lavatories in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2 CLEAN-UP

Components must be cleaned after installation and covered to protect against damage during completion of the remaining project items. Damaged components must be repaired or replaced at the Contractor's sole expense.

-- End of Section --

SECTION 07 05 23

PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS
08/19

PART 1 GENERAL

1.1 SUMMARY

Employ an independent agency to conduct the pressure test on the building envelope in accordance with this specification section and ASTM E779.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referenced within the text by the basic designation only.

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	(2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel
ASNT CP-105	(2011) ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel - Item No. 2821
ASNT SNT-TC-1A	(2020) Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

ASTM INTERNATIONAL (ASTM)

ASTM E779	(2019) Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
ASTM E1186	(2017) Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
ASTM E1258	(1988; R 2018) Standard Test Method for Airflow Calibration of Fan Pressurization Devices
ASTM E1827	(2011; R 2017) Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 6781	(1983) Thermal Insulation - Qualitative Detection of Thermal Irregularities in Building Envelopes - Infrared Method
ISO 6781-2	(2010) Performance of Buildings -

Detection of Heat, Air, and Moisture
Irregularities in Buildings by Infrared
Methods - Part2: Equipment Requirements

ISO 6781-3

(2015) Performance of Buildings -
Detection of Heat, Air, and Moisture
Irregularities in Buildings by Infrared
Methods - Part 3: Qualifications of
Equipment Operators, Data Analysts, and
Report Writers

1.3 DEFINITIONS

The following terms as they apply to this section:

1.3.1 Air Barrier Envelope

The surface that separates the inside air from the outside air. The combination of air barrier assemblies and air barrier components, connected by air barrier accessories are designed to provide a continuous barrier to the movement of air through an environmental separator. A single building may have more than one air barrier envelope. The air barrier surface includes the top, bottom, and sides of the envelope. The term "air barrier envelope" is also known as "air barrier system" or simply "air barrier".

1.3.2 Air Leakage Rate

How leaky, or conversely how air tight a building envelope is. The air leakage is normally described in terms of air flow rate for the surface area of the envelope at a defined differential pressure.

1.3.3 Bias Pressure

Also known as zero flow pressure, baseline pressure, offset pressure or background pressure. With the envelope not artificially pressurized, bias is the differential pressure that always exists between the envelope that has been prepared (sealed) for the pressure test and the outdoors. Bias pressure is made up of two components, fixed static offset (usually due to stack effect or the HVAC system) and fluctuating pressure (usually due to wind or a moving elevator). Because of pressure fluctuations many bias pressure readings are recorded and averaged for use in the calculations.

1.3.4 Blower Door

Commonly used term for an apparatus used to pressurize and depressurize the space within the building envelope and quantify air leakage through the envelope. The blower door typically includes a door fan and an air resistant fabric or a series of hard panels that extends to cover and seal the door opening between the fan shroud and door frame. The door fan is a calibrated fan capable of measuring air flow and is usually placed in the opening of an exterior door. With the air barrier otherwise sealed, air produced by the door fan pressurizes or de-pressurizes the envelope, depending on the fan's orientation.

1.3.5 Environmental Separator

The parts of a building that separate the controlled interior environment from the uncontrolled exterior environment, or that separate spaces within

a building that have dissimilar environments. The term "environmental separator" is also known as the "control layer".

1.3.6 Pressure Test

A generic term for a test in which the envelope is either pressurized or de-pressurized with respect to the outdoors.

1.3.6.1 Negative Pressure Test (Depressurization Test)

A test wherein air inside the envelope is drawn to the outdoors. This places the envelope at a lower (negative) pressure with respect to the outdoors.

1.3.6.2 Positive Pressure Test (Pressurization Test)

A test wherein outdoor air is pushed into the envelope. This air movement places the envelope at a higher (positive) pressure with respect to the outdoors.

1.4 WORK PLAN

Submit the following not later than 120 calendar days after contract award, but before start of pressure testing work, steps to be taken by the lead pressure test technician to accomplish the required testing.

a. Memorandum of test procedure.

(1) Proposed dates for conducting the pressure, thermographic and fog tests.

(2) Submit detailed pressure test procedures prior to the test.
Provide a plan view showing proposed locations (personnel doors or other similar openings) to install blower doors or flexible ducts (for trailer-mounted fans), if used.

b. Test equipment to be used.

c. Scaffolding, scissor lifts, power, electrical extension cords, duct tape, plastic sheeting and other Contractor's support equipment required to perform all tests.

d. Other Contractor's support personnel who will be on site for testing.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Work Plan; G

SD-03 Product Data

Thermal Imaging Camera; G

SD-07 Certificates

Pressure Test Agency

Thermographer Qualifications

Test Instruments

Date Of Last Calibration

SD-06 Test Reports

Pressure Test Procedures; G

Air Leakage Test Report; G

Diagnostic Test Report; G

1.6 QUALITY ASSURANCE

1.6.1 Modification of References

Perform all pressure and diagnostic tests according to the referenced publications listed in paragraph REFERENCES and as modified by this section. Consider the advisory or recommended provisions, of the referred references, as mandatory.

1.6.2 Qualifications

1.6.2.1 Pressure Test Agency

Submit, no later than 15 calendar days after contract award, information certifying that the pressure test agency is not affiliated with any other company participating in work on this contract. The work of the test agency is limited to pressure testing the building envelope, performing a thermography test and fog test, and investigating, through various methods, the location of air leaks through the air barrier. See paragraph PRESSURE TEST AGENCY for additional requirements. For thermographer qualifications, see paragraph THERMOGRAPHER QUALIFICATIONS.

Use the sample TEST AGENCY QUALIFICATIONS SHEET form (Appendix C), to submit the following information.

- a. Verification of 2 years of experience as an agency in pressure testing commercial and/or industrial buildings.
- b. List of at least ten commercial/industrial facilities with building envelopes that the agency has tested within the past 2 years. Include building name, address, and name of prime construction contractor and contractor's point-of-contact information.
- c. Confirmation of 2 years of commercial and or industrial building pressure test experience for the lead pressure test technician and the thermographer in using the specified ASTM E779 testing standard. References from five Contracting Officers for facilities where the lead test technician has supervised commercial and or industrial building pressure tests in the last 2 years.
- d. Verification that the lead pressure test technician has been employed

by a building pressure testing agency in the capacity of a lead pressure test technician for not less than 1 year.

1.6.2.2 Thermographer Qualifications

To perform an infrared diagnostic evaluation, use a lead thermographer who has at least an active Level II Certification that is based on the requirements in ASNT CP-105 or ANSI/ASNT CP-189 and is in accordance with ASNT SNT-TC-1A. The course of study is to be specifically focused on infrared thermography for building science. The thermographer must have at least two years of building science thermography experience in IR testing commercial or industrial buildings. The thermographer must also have experience in building envelopes and building science in order to make effective recommendations to the contractor should the envelope require additional sealing. Thermographic equipment operators, data analysts and report writers must comply with the requirements of ISO 6781-3. Submit the thermographer's certificate for approval. Submit a list of at least ten commercial/industrial buildings on which the thermographer has performed IR thermography in the past two years. The thermographer is to have a current active certification. Submit certification at least 60 days prior to thermography testing.

1.6.3 Test Instruments and Date of Last Calibration

Submit a signed and dated list of test instruments, their application, manufacturer, model, serial number, range of operation, accuracy and date of most recent calibration. Calibration data applicable to fan systems must be in accordance with ASTM E1258.

1.6.4 Test Reports

No later than 14 days after completion of the pressure test, submit electronic copies of an organized report. The report is to contain a table of contents, an executive summary, an introduction, a results section and a discussion of the results. Submit the air leakage test report as described in paragraph AIR LEAKAGE TEST REPORT. Submit a diagnostic test report as described in paragraph LOCATING LEAKS BY DIAGNOSTIC TESTING. The diagnostic test report is to include the Thermographic Investigation Report and the Fog Test Report (if performed).

Submit field data and completed report forms found in the appendices. Use the sample forms, Test Agency Qualification Sheet, Air Leakage Test Form and Air Leakage Test Results Form to summarize the tests for the appropriate building envelope. Submit both electronically populated and field hand filled-in forms.

Report Data. Include in the report the following information for all tests:

- a. Date of issue
- b. Project title and number
- c. Name, address, and telephone number of testing agency
- d. Dates and locations of samples and tests or inspections
- e. Names of individuals making the inspection or test

- f. Designation of the work and test method
- g. Identification of product and specification section
- h. Complete inspection or test data
- i. Test results and an interpretation of test results
- j. Comments or professional opinion on whether inspected or tested work complies with contract document requirements
- k. Recommendations on retesting

1.7 CLIMATE CONDITIONS SUITABLE FOR A PRESSURE TEST

As the test date approaches, monitor the weather forecast for the test site. Avoid testing on days forecast to experience high winds, rain, or snow. Monitor weather forecasts prior to shipping pressure test equipment to the site. Based on current and forecast weather conditions, the Contracting Officer's representative is to grant final approval for testing to occur.

1.7.1 Rain

For safety reasons, avoid testing during rain or if rain is anticipated during testing. If pneumatic hoses are installed and exposed to rain inspect the hose to insure rainwater has not migrated into the hose ends. Orient all exposed hose ends to keep them out of water puddles. Success in temporarily sealing outdoor ventilation components such as louvers and exhaust fans may also be compromised by rain. Don't seal roof-mounted ventilation components during times of potential lightning.

1.7.2 Wind

Because wind can skew pressure test results, test only on days and at times when winds are anticipated to be the calmest. Avoid pressure testing during gusty or high wind conditions. Avoid installing test fans on the windward side of the building if wind gusts during the test are anticipated to be greater than 10 miles per hour.

PART 2 PRODUCTS

2.1 PRESSURE TEST EQUIPMENT

Depending on site conditions and size of the envelope, the test may be conducted using blower door equipment and/or trailer-mounted fans. The testing agency is to supply sufficient quantity of blower equipment that will produce a minimum of 75 Pa differential pressure between the envelope and outdoors using the test methods described herein. Supplying additional blower test equipment to provide additional airflow capacity or to act as a backup is highly recommended.

2.1.1 Blower Door Fans and Trailer Mounted Fans

Each air flow measuring system including blower door fans and trailer mounted fans are to be calibrated within the last 5 years. Calibrated blower door fans and trailer mounted fans must measure accurately to within plus or minus 5 percent of the flow reading. Blower door equipment and trailer mounted fans are to be specifically designed to pressurize

building envelopes. Each set of blower door equipment is to include fan(s), digital gage(s), door frame, door fabric or hard panels.

2.1.2 Digital Gages as Test Instruments

Use only digital gages as measuring instruments in the pressure test; analog gages are not acceptable. The gauges must be accurate to within 1.0 percent of the pressure reading or 0.15 Pa, whichever is greater. Each gage is to have been calibrated within two years of the test. The calibration is to be checked against a National Institute of Standards and Technology (NIST, formerly National Bureau of Standards) traceable standard.

2.2 THERMAL IMAGING CAMERA REQUIREMENTS

The thermal imaging camera used in the thermography test must have a thermal sensitivity (Noise Equivalent Temperature Difference.) of +/- 0.18 degrees F at 86 degrees F or less. Ensure the camera's operating spectral range falls between 2 and 15 micrometers. Ensure the camera's IR image viewing screen resolution measures at least 320x240 pixels. Ensure the camera has a means of recording thermal images seen on the camera viewing screen. The camera is to display output as individual still frame images that also can be downloaded and inserted into an electronic Thermographic Investigation Report. All thermographic equipment must comply with the requirements of ISO 6781-2. Submit camera make and model, and catalog information that defines the camera thermal sensitivity for approval.

PART 3 EXECUTION

3.1 PRESSURE TEST AGENCY

The test agency is to be an independent third party subcontractor, not an affiliated or subsidiary of the prime contractor, subcontractors or A/E firm. The agency is to be regularly engaged in pressure testing of commercial/industrial building envelopes. If using blower door or trailer-mounted fans, the lead test technician must have at least two years of experience in using such equipment in building envelope pressurization tests. Formal training using pressure test equipment is highly recommended. Technicians using the building's air handling system for pressure testing are to have tested at least five commercial/industrial buildings within the past two years with each building having over 50,000 square feet of floor area. Submit the name, address and floor areas of each of these five buildings for approval.

3.1.1 Field Work

The lead pressure test technician and thermographer are to be present at the project site while testing is performed and is to be responsible for conducting, supervising, and managing of their respective test work. Management includes health and safety of test agency employees.

3.1.2 Reporting Work

The lead pressure test technician is to prepare, sign, and date the test agenda, equipment list, and submit a certified Air Leakage Test Report. The thermographer is to prepare, sign, and date the test agenda, equipment list, and submit a certified Thermographic Investigation Report. The contractor is to prepare a final report that identifies improvements that were made to the envelope to reduce air leaks, mitigate thermal bridging,

eliminate moisture migration, repair insulation voids discovered during diagnostic tests. Jointly submit all reports.

3.2 ENVELOPE SURFACE AREA CALCULATION

The architectural air barrier boundary includes the floor, walls, and ceiling. After construction of the air barrier envelope is complete, field measure the envelope to ensure the physical measurements match the design drawings and the air barrier envelope surface area calculations are generated. If the calculation result is not within 10 percent of the defined air barrier boundary calculation result as indicated, submit the envelope surface area calculation and results for review.

3.3 PREPARING THE BUILDING ENVELOPE FOR THE PRESSURE TEST

3.3.1 Testing During Construction

The pressure test cannot be conducted until all components of the air barrier system have been installed. After all sealing as described herein has been completed, inspect the envelope to ensure it has been adequately prepared. During the pressure test, stop all ongoing construction within and neighboring the envelope which may impact the test or the air barrier integrity. The pressure test may be conducted before finishes that are not part of the air barrier envelope have been installed. For example, if suspended ceiling tile, interior gypsum board or cladding systems are not part of the air barrier the test can be conducted before they are installed. Recommend testing prior to installing the finished ceilings within the envelope and immediately surrounding it. The absence of finished ceilings allows for inspection and diagnostic testing of the roof/wall interface and for implementation of repairs to the air barrier, if necessary to comply with the maximum allowed leakage.

3.3.2 Sealing the Air Barrier Envelope

Seal all penetrations through the air barrier. Unavoidable penetrations due to electrical boxes or conduit, plumbing, and other assemblies that are not air tight are to be made so by sealing the assembly and the interface between the assembly and the air barrier or by extending the air barrier over the assembly. Support the air barrier so as to withstand the maximum positive and negative air pressure to be placed on the building without displacement or damage, and transfer the load to the structure. Durably construct the air barrier to last the anticipated service life of the assembly and to withstand the maximum positive and negative pressures placed on it during pressure testing. Do not install lighting fixtures that are equipped with ventilation holes through the air barrier.

3.3.3 Sealing Plumbing

Prime all plumbing traps located within the envelope full of water.

3.3.4 Close and Lock Doors

Close and lock all doors and windows in the envelope perimeter. For doors not equipped with latching hardware, temporarily secure them in the closed position. Secure the doors in such a way that they remain fully closed even when the maximum anticipated differential air pressure produced during the test acts on them.

3.3.5 Hold Excluded Building Areas at the Outdoor Pressure Level

Keep building areas immediately surrounding but excluded from the test envelope at the outdoor pressure level during the pressure test. Maintain these areas at the outdoor pressure level by propping exterior doors open, opening windows and de-energizing all air moving devices in or serving these areas.

3.3.6 Maintain an Even Pressure within the Envelope

Ensure the pressure differences within the envelope are minimized by opening all internal air pathways including propping open all interior doors. Distribute test fans throughout the envelope as necessary to ensure the internal pressures are uniform (within 10 percent of the average differential pressure). Ideally, do not install suspended ceilings until after all pressure tests have been completed. If, however the envelope includes finished suspended ceiling spaces, temporarily remove approximately 5 percent of all ceiling tiles or a minimum of 1 tile from each isolated suspended ceiling space, whichever comprises the greatest surface area. Temporarily remove additional ceiling tiles during testing to allow for inspection and diagnostic testing of the ceiling/wall interface. An alternative to removing ceiling tiles is to measure the differential pressure between each isolated suspended ceiling space and the outdoors when the area below the suspended ceiling is maintained at a differential pressure of 75 Pa with respect to the outdoors. If the suspended ceiling differential pressure measurement is within ten percent of the 75 Pa pressure below the suspended ceiling no ceiling tiles need to be removed.

3.3.7 Maintain Access to Mechanical and Electrical Rooms

Maintain access to mechanical rooms and electrical rooms associated with the envelope to allow for de-energizing ventilation equipment and resetting circuit breakers tripped by blower door equipment, if used.

3.3.8 Minimize Potential for Blowing Dust and Debris

Because high velocity air will be blown into and out of the envelope during the test, debris, including dust and litter, may become airborne. Airborne debris may become trapped or entangled in test equipment, thereby skewing test results. Ensure areas within and surrounding the envelope are free of dust, litter and construction materials that are easily airborne. If pressurizing existing, occupied areas, provide adequate notice to building occupants of blowing dust and debris, and general disruption of normal activities during the test.

3.3.9 De-energize Air Moving Devices

De-energize all air moving devices serving the envelope to keep air within the envelope as still as reasonably achievable. De-energize all fans that deliver air to, exhaust air from, or recirculate air within the envelope. Also de-energize all fans serving areas adjacent to but excluded from the envelope.

3.3.10 Installing Blower Door Equipment in a Door Opening

Where blower door fans are used, before installing blower door equipment, select a door opening that does not restrict air flow into and out of the envelope and has at least 5 feet clear distance in front of and behind the

door opening. Disconnect the door actuator and secure the door open to prevent it from being drawn into the fan by fan pressure. Avoid installing blower door equipment on the windward side of the building.

3.4 BUILDING ENVELOPE AIR TIGHTNESS REQUIREMENT

For each building envelope, perform the Architectural Only test. The purpose of the pressure (air leakage) test is to determine final compliance with the airtightness requirement by demonstrating the performance of the continuous air barrier. An effective air barrier envelope minimizes infiltration and exfiltration through unintended air paths (leaks). The tests may be performed in any desired order.

3.4.1 Architectural Only Test

The test envelope is the architectural air barrier boundary as defined on the contract drawings. This boundary includes connecting walls, roof and floor which comprise a complete, whole, and continuous three dimensional envelope. Perform both a positive pressure test and a negative pressure test on this envelope, unless otherwise directed.

3.4.1.1 Test Goal

Input data from the test into the Air Leakage Rate by Fan Pressurization spreadsheet as described in paragraph CALCULATION PROGRAM via the Air Leakage Test Form. Compare output from the spreadsheet against the maximum allowable leakage defined in Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM. The envelope passes the test if the leakage rate, as calculated using the spreadsheet, is equal to or lower than the Architectural Only leakage rate goal.

3.4.1.2 Preparing the Envelope for the Pressure Test - Seal All Openings through the Air Barrier

Temporarily close all perimeter windows, roof hatches and doors in the envelope perimeter except for those doors that are to remain open to accommodate blower door or trailer mounted fan test equipment installation. Seal, or isolate all other intentional openings, pathways and fenestrations through the architectural envelope prior to pressure testing. Follow the Recommended Test Envelope Conditions identified in ASTM E1827, Table 1, for the Closed Envelope condition. These openings may include boiler flues, fuel-burning water heater flues, fuel-burning kitchen equipment, clothes dryer vents, fireplaces, wall or ceiling grilles, diffusers etc. Before sealing flues, close their associated fuel valves and verify the associated pilot lights are extinguished. Prime all plumbing traps located within the envelope full of water. In lieu of applying tape and/or plastic, typical temporary sealing materials include tape and sheet plastic or a self-adhesive grille wrap. Use and apply tape and plastic in a manner that does not deface or remove paint or mar the finish of permanent surfaces. Be especially aware of residue that remains from tape applied to stainless steel surfaces such as kitchen hoods or rollup doors. For painted surfaces, use tape types that do not remove finish paint when the tape is removed. If paint is removed from the finished surface, repaint to match existing surfaces. Secure dampers closed either manually or by using the building's HVAC system controls. Use the table below for further guidance in building preparation.

Building Component	Envelope Condition
Air handling units, duct fans	As found (open) or temporarily sealed as necessary
Clothes dryer	Off
Clothes dryer vents	Temporarily sealed
Dampers - intake, exhaust	Physically closed or closed using control power or temporarily sealed
Diffusers, registers, grilles within the envelope	Temporarily sealed
Doors, personnel type, at the envelope perimeter	Secured closed
Doors, personnel type, within the envelope	Secured (propped) open
Doors, roll-up type, at the envelope perimeter	Closed (no additional sealing)
Exhaust hoods	Closed* and temporarily sealed
Fireplace hearth	Temporarily sealed *
Kitchen hoods	Temporarily sealed *
Pilot light and associated fuel valve	Extinguished and closed, respectively
Vented combustion appliance	Temporarily sealed *
Vented combustion appliance exhaust flue	Off
Windows	Secured closed
* If the building component has an associated manual or automatic damper, consider securing the damper closed in lieu of temporarily sealing.	

3.5 CONDUCTING THE PRESSURE TEST

Notify the Contracting Officer at least 10 working days before conducting the pressure tests to provide the Government the opportunity to witness the tests and to monitor weather forecasts for conditions favorable for testing. Do not pressure test until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions. During the pressure test periodically inspect temporarily sealed items to ensure they are still sealed. Seals on temporarily sealed items tend to release more readily at higher pressures. Test data obtained after temporarily sealed items become unsealed cannot be used as input into the calculation program. Follow the Envelope Pressure Test Procedures in the paragraphs below. Submit detailed pressure test procedures indicating the test apparatus, the test methods and procedures, and the analysis methods to be employed for the building envelope pressure (air tightness) test. Submit these procedures not later than 60 days after Notice to Proceed.

3.5.1 Extend Pneumatic Tubes and Establish a Reference Differential Pressure

Confirm the various zones within the envelope have a relatively uniform interior pressure distribution by establishing a representative differential pressure between the envelope and the outdoors with blower door or trailer-mounted fans operating. The number of indoor pressure difference measurements (pneumatic hoses) required depends on the number of interior zones separated by bottle necks that could create significant pressure drops (e.g. doorways and stairwells). Extend at least four pneumatic hoses (differential pressure monitoring ports) to locations within the envelope that are physically opposite of each other. In multiple story buildings, especially those over three stories, extend hoses to multiple floors. Locate the hose ends away from the effects of air discharge from blower test equipment. Select one of the four (or more) interior hoses, one judged by the test agency to be the most unaffected by air velocity produced by blower test equipment, to serve as the interior reference pressure port. Extend at least one additional pneumatic hose to the outdoors (outdoor pressure port). To the end of this hose manifold at least four hoses together and terminate each hose on a different side of the building. With the envelope sealed and the blowers energized, measure the differential pressure using the interior reference pressure port and the four outdoor pressure ports. Then measure and record the differential pressure by individually using each of the remaining three interior hoses. Ensure each reading is within plus or minus 10 percent of the reference reading. Thus at an average 75 Pa maximum pressure difference across the envelope, the difference between the highest and lowest interior pressure difference measurements should be 15 Pa or less. If this condition cannot be met, attempt to create additional air pathways within the envelope to minimize pressure differences within the envelope. If necessary, move the interior hose ends. See step 2.13 of the Air Leakage Test Form in Appendix A.

3.5.2 Bias Pressure Readings

With the fan pressurization equipment de-energized and the envelope sealed, obtain the differential pressure between the outdoors and the envelope. Record 12 bias pressure readings before the pressure test and 12 bias pressure readings after the pressure test. Each reading is the average of ten or more 1-second measurements. Include positive and negative signs for each reading. To help dampen bias pressures that significantly contribute to test pressure, reduce temperature differences between indoor and outdoor air. Temperature differences can be reduced by operating test fan equipment for a few minutes to replace most of the indoor air with outdoor air.

3.5.3 Testing in Both Positive and Negative Directions

The preferred method for testing a building envelope is to test in both the pressurized and depressurized directions. Testing in one direction is only allowed if opposite direction testing cannot logistically be performed due to test equipment limitations or restrictions. After obtaining the pre-test bias differential pressure readings, conduct the pressure test. Record the envelope pressures (in units of Pascals) from one interior pneumatic hose (monitoring port) and the outdoor pneumatic hose(s), averaged or manifolded, with corresponding flows (in units of cfm) for each fan. Record the flow rates at at least 10 to 12 positive and 10 to 12 negative building pressure readings. If conducting both positive and negative pressure tests the lowest allowable test pressure is 40 Pa

and the highest test pressure is 85 Pa. Keep at least 25 Pa difference between the lowest and highest test pressure readings. Include the 75 Pa pressure value between the lowest and highest readings. The 10 to 12 readings in each direction are to be roughly evenly spaced along the range of pressures and flows. After testing is complete de-energize the equipment used to provide pressurization and obtain an additional 10 to 12 post-test bias pressure readings. None of the bias pressure readings are allowed to exceed 30 percent of the minimum test pressure. If these limits are exceeded the test fails and must be repeated.

3.5.4 Failed Pressure Test

If the pressure test fails to meet the established criteria, use diagnostic test methods described in paragraph LOCATING LEAKS BY DIAGNOSTIC TESTING to discover the leak locations. Provide additional permanent sealing measures to reduce or eliminate leak sources discovered during diagnostic testing. Retest (perform another pressure test) after sealing has been completed. Repeat this sequence of documenting test results in the test report, performing diagnostic tests, documenting recommendations for additional sealing measures in the test report, sealing leak locations per recommendations, and re-testing as necessary until the building envelope passes the pressure test and is in compliance with the performance requirements.

3.5.5 Air Leakage Test Report

Report volumetric flow rates and corresponding differential pressures in cubic feet per minute (cfm) and Pascals (Pa), respectively, on the Air Leakage Test Form sample form found in Appendix A. Populate the accompanying spreadsheet file entitled Pressure Test Data Analysis with information obtained during the test. The spreadsheet uses equations found in ASTM E779 as a basis for calculating the envelope leakage rate. Other similar leakage rate calculation programs cannot be used or submitted for review. Submit a printout of the data input and output in the report. Should any air tightness (pressure) test fail, the pressure test report is to include data and results from all previous failed tests along with the final successful test data and results. Indicate if the resulting leakage rate did or did not meet the goal leakage requirement. Identify and document deficiencies in the building construction upon failure of a test to meet the specified maximum leakage rate.

Include the Test Agency Qualification Sheet, Air Leakage Test Form and Air Leakage Test Results Form in the written report. Document every test set-up condition with diagrams and photos to ensure the tests can be made repeatable. Document all pneumatic hose termination locations. Record in detail how the building envelope was prepared for the tests. Also describe in detail which building items were temporarily sealed. Include photos of test equipment and sealing measures in the report. Include an electronic (pdf) version of all test reports on a CD. If the building envelope fails to meet the leakage rate goal, provide recommendations to further seal the envelope and document these recommendations in the test report.

3.6 LOCATING LEAKS BY DIAGNOSTIC TESTING

Use diagnostic test methods described herein to discover obvious leaks through the envelope. Perform diagnostic tests on the building envelope regardless of the envelope meeting or failing to meet the designated leakage rate goal. Use diagnostic test methods in accordance with

ASTM E1186 and in conjunction with pressurization equipment as necessary. Use the thermography diagnostic test to establish a baseline for envelope leakage. Apply additional diagnostic tests (find, feel, fog or other tests) as necessary to further define leak locations and pathways discovered using thermography or to find additional leaks not readily detected by thermography. Using a variety of diagnostic tests may help locate leaks that would otherwise go undetected if only a single diagnostic test were used. Pay special attention to locating leaks at interfaces where there is a change in materials or a change in direction of like materials. These interfaces, at a minimum, include roof/wall, wall/wall, floor/wall, wall/window, wall/door, wall/louver, roof mounted equipment/roof curb interfaces and all utility penetrations (ducts, pipes, conduit, etc) through the envelope's architecture. Also use diagnostic tests to check for leakage between the air duct and duct damper, when the damper, under normal control power, is placed in the closed position. Should leaks be discovered during diagnostic tests, thoroughly document their exact locations on a floor plan so that sealing can be later applied, if required or as directed. If the envelope passes the leakage test, use the diagnostic test procedure described above to identify obvious leakage locations. Seal the leaks at the discretion of the COR based on the magnitude, location, potential for liquid moisture penetration or retention, potential for condensation, presence of daylight through an architectural surface or if the leakage location could potentially cause rapid deterioration or mold growth of, or in the building envelope materials and assemblies. Apply sealing measures after diagnostic testing is complete and all pressurization blowers are off. To verify that the applied sealing measures that are effective, re-test for leaks using the same diagnostic methods that discovered the leak. Reseal and retest until the envelope meets the leakage rate goal and all obvious leaks through the envelope are sealed.

3.6.1 Find Test

Use visual observation to locate daylight and/or artificial light streaming from the opposite side of the envelope. Observe all interfaces identified above.

3.6.2 Feel Test

Use the building's air handling system or blower door equipment to negatively pressurize the building envelope, to at least 25 Pa but no greater than 85 Pa, with respect to the outdoors. The larger the pressure difference, the easier discovering leaks by feeling them becomes. While inside the envelope, hand feel roof/wall, wall/wall, and floor/wall interfaces and utility penetrations (ducts, pipes, conduit, etc) for leaks and note the leak locations on a floor plan. The "Feel" test may also be used to check for leaks between the ductwork and ductwork damper. To do this, positively pressurize the envelope and check for air movement from the envelope exterior.

3.6.3 Infrared Thermography Test

Avoid performing thermography tests just after pressure testing the building envelope (pressurizing and/or depressurizing the building envelope) as thermography readings may be inaccurate due to excessive air-wash. Perform thermography either before the pressure test or wait an appropriate amount of time after pressure test completion for the temperatures within the building envelope to stabilize before starting the thermography tests. Coordinate thermography examination with the pressure

test agency and the test agency's pressurization equipment. The pressure test agency is to allow adequate time for the thermographer to perform a complete thermographic examination, as described hereinafter, of the envelope interior and exterior.

3.6.3.1 Thermography Test Methods

Before thermographic testing, remove furniture, construction equipment, and all other obstructions both inside and outside the building as necessary to gain a clear field of view. In the Thermographic Investigation Report, document all areas where obstructions remain. For exterior thermal examination of the envelope, verify that no direct solar radiation has heated the envelope surfaces to be examined for a period of approximately 3 hours for frame construction and for approximately 8 hours for masonry veneer construction. Conduct exterior investigations after sunset, before sunrise, or on an overcast day when the influence of solar radiation can be determined to be minimal. Limit exterior examinations to times when the influence of solar radiation is minimal, such as after sunset or before sunrise or during an overcast day. Conduct thermal imaging tests only when wind speeds are less than 8 mph at the time of analysis and at the end of analysis. Document any variations in wind during the test. Document all variations of test conditions in the Thermographic Investigation Report. Test only when exterior surfaces are dry. Monitor and document ongoing test parameters, such as the temperatures inside and outside the air barrier envelope, wind speed, and differential pressure.

3.6.3.1.1 Thermography Testing of the Air Barrier

Test the building envelope in accordance with ISO 6781, and ASTM E1186. Perform a complete thermographic inspection consisting of the full inspection of the interior and exterior of the complete air barrier envelope. Document envelope areas that are inaccessible for testing. Use infrared thermography technology in concert with standard pressurization methods (blower doors, trailer mounted fans and/or the building's own air handling systems) to locate leaks through the air barrier. Because thermography works best with at least a 18 degree F temperature difference between the envelope interior and the exterior, adjust the HVAC system, if possible, to create or enhance this temperature difference. The minimum allowable temperature difference is 3 degrees F. Maintain this temperature difference for at least 3 hours prior to the test. Use pressurization methods to establish a minimum of +20 Pa pressure difference with respect to the outdoors while using an infrared camera to view the envelope from outdoors. When viewing with the camera from inside the envelope, keep the envelope at a pressure differential of -20 Pa with respect to the outdoors using pressure testing equipment or the building's own air handling system.

3.6.3.2 Thermography Test Results

Document the location of all leaks, anomalies, and unusual thermal features on a floor plan and/or elevation view and catalog them with a visible light picture for locating the defect for correction. The thermographer is to recommend corrective actions to eliminate the leaks, anomalies and unusual thermal features. Where leaks are found perform corrective sealing as necessary to achieve the whole envelope air leakage rate specified. After sealing, again use thermography in concert with standard pressurization methods to verify that the air leakage has been reduced. After these leaks have been permanently sealed note all actions

taken on the drawings or in the Thermographic Investigation Report. Submit the drawings for approval as part of the Thermographic Investigation Report. Also include thermographic photos that show where leaks were discovered. Include thermograms using an imaging palette that clearly shows the observed thermal patterns indicating air leakage. The Contracting Officer's Representative is to witness all testing.

3.6.4 Fog Test

Before using a theatrical fog generator, disable all building smoke detectors as they may alarm when fog is issued. Coordinate fog tests and the disabling of all smoke detectors with the Contracting Officer's representative and the local fire department as necessary. Use pressure test equipment or the buildings own air handling system to positively pressurize the building envelope to at least 25 Pa but not greater than 85 Pa over the outdoors. Using a theatrical fog generator within the envelope, direct fog at suspected leakage points such as at building interfaces. Test the following interfaces: roof/wall, wall/wall, floor/wall, wall/window, roof/mounted mechanical equipment. From the vantage point immediately outside the envelope and opposite that of the interface being tested, observe the effect as the fog is issued. Detection may also be further enhanced by using a scented fog liquid or a fog liquid that produces a colored fog. Look for fog and smell for associated odor percolating through the interface. Also use smoke puffers and smoke sticks as necessary to locate leaks at these and other interface locations. If the Architectural Plus HVAC System pressure test will be/was performed introduce fog into ductwork to check for leakage between ductwork and associated dampers. After fog testing has ended, reactivate the building smoke detectors and notify the Contracting Officer and local fire department that the test has ended. After sealing has been completed retest these areas using fog. Seal additional leaks that are found.

3.6.5 Diagnostic Test Report

Once the diagnostic tests have been completed and the leakage locations identified and sealed, document these procedures, locations and recommendations in the diagnostic test report. Submit plan and/or profile drawings that thoroughly identify leak locations. Describe in detail all leak locations so that the seal-up crew knows where to apply sealing measures. After sealing measures have been applied, describe the methods used along with applicable photos of the final sealed condition.

3.6.5.1 Thermographic Investigation Report

Submit a report of each thermographic investigation identifying the thermal discontinuities in the thermal control layer. Indicate in the final report locations to which improvements for both the air control layer and the thermal control layer were made to reduce air leaks and correct discontinuities in the thermal control layer. Include in the report some selected radiometric images of suspected failure points in the air barrier envelope that indicate before and after conditions. Devote a chapter(s) of the Thermographic Investigation Report to identifying suspected points of thermal bridging, moisture migration through roofs and walls, and insulation voids. Indicate in the final report improvements that were made to the envelope to reduce air leaks. Include the following items in the report:

- a. Brief description of the building construction

- b. Types of interior and exterior surface materials used in the building.
- c. Geographical orientation of the building with a description of the exterior surroundings including other buildings, vegetation, landscaping, and surface water drainage.
- d. Camera brand, model and serial number, and date of most recent calibration date; optional lenses with serial numbers (if applicable)
- e. Thermographer's and Government Inspector's names
- f. Date and time of tests
- g. Air temperature and humidity inside the air barrier envelope
- h. Outdoor air temperature and humidity
- i. General information for the last 12 hours on the solar radiation conditions in the geographic area where the test is being performed.
- j. Ambient conditions such as precipitation and wind direction and speed occurring with the last 24 hours, as applicable. Refer to specific requirements in each section of each thermographic inspection type for requirements in each specific area.
- k. Documentation of those portions of the building envelop which were not within test conditions when the scan was performed and which portions were obstructed by adjacent structures, interior furnishings, intervening cavities or reflective surfaces.
- l. Other relevant information, which may have influenced test results.
- m. Drawings, sketches, floor plans and/or photographs detailing the locations in the buildings where thermograms were taken detailing possible irregularities in the components being tested.
- n. Thermal images taken during the inspection with their relative locations and written or voiced recorded explanations of the anomaly listed along with visual and reference images.
- o. An identification of the aspects or components of the building being examined.
- p. Explanations for the type and the extent of each construction defect observed during the inspection.
- q. Any results from additional measurements and investigations. Identify additional equipment used and support with type, model number, serial number and date of most recent calibrated.

3.6.5.2 Fog Test Report

Document all turbulent air flow and dead air spaces within the envelope. Report fog behavior as it exits from and/or is entrained within the building. Include a floor plan in the report that documents the locations where fog passed through the envelope.

3.7 CALCULATION PROGRAM

To calculate the envelope leakage rate and other required outputs, input the data obtained during the pressure tests as documented in the Air Leakage Test Form (Appendix A) into the Air Leakage Rate by Fan Pressurization Excel spreadsheet. This spreadsheet can be found at the following web site:

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic>

3.8 AFTER COMPLETION OF THE PRESSURE AND/OR DIAGNOSTIC TEST

After all pressure and/or diagnostic testing has been completed unseal all temporarily sealed items. Unless otherwise directed by the Contracting Officer, return all dampers, doors, and windows to their pre-test condition. Remove tape and plastic from all temporarily sealed openings, being careful not to deface painted surfaces. If paint is removed from finished surfaces, repaint to match existing surfaces. Unless otherwise directed by the Contracting Officer's representative, return fuel (gas) valves to their pre-test position and relight pilot lights. Return all fans and air handling units to pre-test conditions.

3.9 REPAIR AND PROTECTION

Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for testing, inspection, and similar services. Upon completion of inspection, testing, or sample taking and similar services, repair damaged construction and restore substrates and finishes, protect construction exposed by or for quality control service activities, and protect repaired construction.

3.10 APPENDICES

The following forms are available for download as a MS Word file at <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic>

Appendix A - Air Leakage Test Form

Appendix B - Air Leakage Test Results Form

Appendix C - Test Agency Qualifications Sheet

-- End of Section --

SECTION 07 13 53

ELASTOMERIC SHEET WATERPROOFING

02/16, CHG 1: 08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C1305	(2008) Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane
ASTM D41/D41M	(2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D146/D146M	(2004; E 2012; R 2012) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D903	(1998; R 2017) Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM D1876	(2008; R 2015; E 2015) Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
ASTM D5385/D5385M	(1993; R 2014; E 2014) Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
ASTM E96/E96M	(2021) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E154/E154M	(2008a; R 2013; E 2013) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Standard Details; G
Elastomeric Waterproofing Sheet Material; G
Protection Board; G
Primers, Adhesives, and Mastics; G

SD-06 Test Reports

Elastomeric Waterproofing Sheet Material; G
Field Quality Control documentation; G
Protective Covering; G

SD-07 Certificates

Elastomeric Waterproofing Sheet Material
Primers, Adhesives, and Mastics
Protective Coverings
Draft Special Warranties
Final Special Warranties
Certificates Of Compliance
Regional Material; S
Recycled Content; S

SD-08 Manufacturer's Instructions

Primers, Adhesives, and Mastics

SD-11 Closeout Submittals

Certificates Of Compliance with sustainable requirements for items listed in SD-07; G

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Sourcing of Raw Materials

Provide recycled content certifications applicable products.

Provide regional material certifications of applicable materials.

1.4 MANUFACTURER'S DETAILS

Submit manufacturer's standard details indicating methods of attachment and spacing, transition and termination details, and installation details. Include verification of existing conditions.

1.5 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for protective coverings, and manufacturer's Safety Data Sheets (SDS) for primers, adhesives, and mastics.

1.6 CODE REQUIREMENTS

Provide membrane waterproofing system in accordance with ICC IBC Section 1805 Dampproofing and Waterproofing.

1.7 DELIVERY, STORAGE, HANDLING, IDENTIFICATION

Deliver and store materials in accordance with manufacturer's printed instructions, out of the weather, in manufacturer's original packaging with brand name and product identification clearly marked. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Do not permit unidentified materials in the work area or in the project.

1.8 ENVIRONMENTAL CONDITIONS

Do not apply waterproofing during inclement weather or when there is ice, frost, surface moisture, or visible dampness on the surface to receive waterproofing for when ambient and surface temperatures are 40 degrees F or below. The restriction on the application of waterproofing materials when ambient and surface temperatures are below 40 degrees F will be waived if the Contractor devises a means, approved by the Contracting Officer in writing, of maintaining the surface and ambient temperatures above 40 degrees F.

1.9 SPECIAL WARRANTIES

1.9.1 Guarantee

Guarantee waterproofing membrane installation against failure due to leaks for a period of two years from the date of Beneficial Occupancy. Submit draft and final guarantees in accordance with Sections 01 78 00 CLOSEOUT SUBMITTALS and 01 78 23 OPERATION AND MAINTENANCE DATA.

1.9.2 Warranty

Provide manufacturer's material warranty for all system components for a period of ten years from the date of Beneficial Occupancy. Submit draft and final warranties in accordance with Sections 01 78 00 CLOSEOUT SUBMITTALS and 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 SUSTAINABILITY CRITERIA

Where allowed by performance criteria:

2.1.1 Reduced Volatile Organic Compound (VOC) Content

Provide products with reduced VOC content and provide certificates of compliance in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS.

2.1.2 Recycled Content

Provide products with recycled content and provide certificates of compliance in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph RECYCLED CONTENT.

2.2 MATERIALS

Provide one of the types of elastomeric waterproofing sheet material and related primers, adhesives, and mastics as specified herein. Ensure compatibility of waterproofing materials with each other, and with materials on which they are applied. Provide materials that comply with applicable requirements cited below when tested in accordance with the referenced ASTM publications.

2.3 COMPOSITE, SELF-ADHERING MEMBRANE SHEETING

Cold applied composite sheet consisting of rubberized asphalt and cross laminated, high density polyethylene film. Not less than 60 mils minimum thickness is required.

2.3.1 Composite, Self-Adhering Sheeting Performance Requirements

- a. Tensile Strength ASTM D412, Die C: 250 psi minimum.
- b. Ultimate Elongation, ASTM D412, Die C: 200 percent minimum.
- c. Water Vapor Transmission, ASTM E96/E96M 80 degrees F Permeance, Procedure B: 0.1 perm maximum.
- d. Pliability degrees, ASTM D146/D146M: (180 degrees Bend Over 1 Inch Mandrel): No cracks at minus minus 25 degrees F.
- e. Provide test report data for crack bridging ability: Either in accordance with ASTM C1305 as modified for a dry film thickness specified by the manufacturer and conducted at low temperature; or in accordance with a cycling over crack test also conducted for the specified dry film thickness at low temperature. Using either test, verify crack bridging up to 1/4 inch without damage to the membrane system.
- f. Puncture Resistance, ASTM E154/E154M REV A: 40 lb minimum.
- g. Lap Adhesion at Minimum Application Temperature, ASTM D1876 Modified, 5 lbs/in.

- h. Peel Strength, ASTM D903: Modified 9 lbs/in.
- i. Resistance to Hydrostatic Head, ASTM D5385/D5385M: 231 ft of water.
- j. Water Absorption, ASTM D570: 0.1 percent maximum.

2.3.2 Primers

Asphalt composition, ASTM D41/D41M, or synthetic polymer in solvent as recommended by the membrane manufacturer.

2.3.3 Mastics

Polymer modified asphalt in suitable solvent of trowel grade consistency and as recommended by the membrane manufacturer.

2.4 Protection Board

Provide protection board that is compatible with the waterproofing membrane.

Three dimensional, high impact resistant polymeric grid with woven monofilament drainage fabric bonded to the grid.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before starting the work, verify surfaces that must be waterproofed are in satisfactory condition. Notify the Contracting Officer of defects or conditions anticipated to prevent a satisfactory application. Do not start application until defects and conditions have been corrected.

3.2 SURFACE PREPARATION

Ensure surfaces to receive treatment are clean, dry, smooth, and free from deleterious materials and projections. Thoroughly wet holes, joints, cracks, and voids in masonry or concrete with water and fill with Portland cement mortar, strike flush, and permit to dry. Cut off high spots or grind smooth. Finish top surfaces of projecting masonry or concrete ledges below grade, except footings, to a steep bevel with Portland cement mortar. Sweep surfaces to receive covering before applying waterproofing to remove dust and foreign matter. Cure concrete by a method compatible with the waterproofing system.

3.3 APPLICATION

3.3.1 Building Envelope Requirements

Provide a continuous waterproofing system at all material and building transitions. Lap, wrap, fasten and seal products in accordance with manufacturer's printed instructions. Envelope assembly variations are not permitted without written approval from the Contracting Officer's Representative.

3.3.2 General Installation Requirements

Provide sheet waterproofing in accordance with manufacturer's printed installation instructions. Ensure the surface to receive membrane is

clean, smooth and dry without surface irregularities; correct deficiencies prior to installation. Where indicated, mop continuous cant strips in place at vertical and horizontal corners before installing the waterproofing membrane. Do not use untreated wood or wood fiber cants. When using solvent welding liquid, avoid prolonged contact with skin and breathing of vapor and provide adequate ventilation. Carry waterproofing of horizontal surfaces up abutting vertical surfaces and adhere solid to the substrate. Avoid wrinkles and buckles in applying membrane and joint reinforcement.

3.3.2.1 Self-Adhering Membrane

Apply composite, self-adhering membrane on surfaces primed at a uniform coverage rate in accordance with membrane manufacturer's printed instructions. Remove release sheet and apply with tacky surface in contact with dried primer.

3.3.2.2 Protection

Protect membrane over horizontal surfaces from traffic during installation. Use only equipment with rubber tires. Provide walkway protection where heavy traffic from other trades is expected. Do not store material on membrane.

3.4 COMPOSITE, SELF-ADHERING MEMBRANE

Lap sheets at edges and ends a minimum of 2-1/2 inches over the preceding sheet. Provide all side laps a minimum 2-1/2 inches and end laps 5 inches. Provide self-adhesive, mastic laps in accordance with manufacturer's recommendation. Roll or firmly press to adhere membrane to substrate. Cover corners and joints with two layers of reinforcement by first applying a 12 inch width of membrane centered along the axis. Flash drains and projections with a second ply of membrane for a distance of 6 inches from the drain or projection. Finish exposed, terminated edges of membrane on horizontal or vertical surfaces with a toweled bead of mastic. Apply mastic around edges of membrane, and drains and projections. Apply mastic at end of each work day.

3.5 FLASHING

Flash penetrations through membrane. Seal all penetrations where reinforcing bars penetrate a waterproofing membrane with the appropriate sealant or mastic flashing component. Embed elastomeric membrane in a heavy coat of adhesive, except for self-adhering membrane. Position continuous metal reglets horizontally on footing and vertically on intersecting and connecting walls, and as specified in Section 07 60 00 FLASHING AND SHEET METAL. Metal reglets are to receive exposed edges of membrane waterproofing. Secure membrane into reglets by lead wedges and fill with cement as recommended in writing by manufacturer of waterproofing materials. Counterflash upper edge of membrane waterproofing and protective covering as specified in Section 07 60 00 FLASHING AND SHEET METAL.

3.6 FIELD QUALITY CONTROL

Notify the Contracting Officer 5 working days prior to date of performing tests. Before concealment, cover elastomeric waterproofing on horizontal surfaces over finished spaces with 4 inches of ponded water for 24 hours. Do not add water after start of 24 hour period. Accurately measure water

level at beginning and end of 24 hour period. If water level falls, remove water and inspect waterproofing membrane. Make repairs or replacement as directed, and repeat test. Do not proceed with work that conceals membrane waterproofing before receiving approval and acceptance of the Contracting Officer.

3.7 PROTECTIVE COVERING

After installation has been inspected and approved by the Contracting Officer, apply a protective covering to the membrane waterproofing prior to backfilling. Protect vertical membrane waterproofing with a 1/2 inch minimum thickness of asphalt plank; 1/2 inch minimum thickness of fiberboard; or 1/8 inch minimum thickness of compatible water resistant bitumen type protection board with edges abutting adjacent edges and exposed surfaces covered by a taping system recommended by manufacturer of protection board. Cover horizontal membrane waterproofing with similar protection board and Portland cement mortar not less than 3/4 inch thick; place uniformly and allow to set before installing subsequent construction.

-- End of Section --

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SECTION 07 21 13

BOARD AND BLOCK INSULATION

02/16, CHG 2: 08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C272/C272M	(2018) Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions
ASTM C612	(2014; R 2019) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C930	(2019) Standard Classification of Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM C1289	(2020) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D1621	(2016) Standard Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2021) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2020) Standard for the Installation of Oil-Burning Equipment
NFPA 54	(2021) National Fuel Gas Code
NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

NFPA 211

(2019) Standard for Chimneys, Fireplaces,
Vents, and Solid Fuel-Burning Appliances

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Standard Details; G

Block or Board Insulation; G

Protection Board or Coatings; G

Accessories including sealants; G

SD-07 Certificates

Block or Board Insulation; G

Protection Board or Coating; G

Draft Special Warranties

Final Special Warranties

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

SD-08 Manufacturer's Instructions

Block or Board Insulation

Adhesive

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of insulation products.

Provide regional material certifications of applicable materials.

1.3.3 IEQ Low-Emitting Materials

For insulation applied inside the weatherproofing system - submit VOC statement indicating compliance with the:

a. VOC Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.4 MANUFACTURER'S DETAILS

Submit manufacturer's standard details indicating methods of attachment and spacing, transition and termination details, and installation details. Include verification of existing conditions.

1.5 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for protection board or coatings, and precautions for flammability and toxicity. Include data to verify compatibility of sealants with insulation.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Deliver materials to the site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.6.2 Storage

Inspect materials delivered to the site for damage and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Comply with manufacturer's recommendations for handling, storage, and protection of materials before and during installation.

1.7 SAFETY PRECAUTIONS

1.7.1 Other Safety Considerations

Comply with the safety requirements of ASTM C930.

1.8 SPECIAL WARRANTIES

1.8.1 Guarantee

Guarantee insulation installation against failure due to ultraviolet light

exposure for a period of three years from the date of Beneficial Occupancy or Substantial Completion. Submit draft and final guarantees in accordance with Sections 01 78 00 CLOSEOUT SUBMITTALS and 01 78 23 OPERATION AND MAINTENANCE DATA.

1.8.2 Warranty

Provide manufacturer's material warranty for all system components for a period of three years from the date of Beneficial Occupancy or Substantial Completion. Submit draft and final warranties in accordance with Sections 01 78 00 CLOSEOUT SUBMITTALS and 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 BLOCK OR BOARD INSULATION

Provide thermal insulating materials as recommended by manufacturer for each type of application indicated. Provide insulation with the following physical properties and in accordance with the following standards:

- a. Mineral Fiber Block and Board: ASTM C612
- b. Faced Rigid Cellular Polyisocyanurate: ASTM C1289 REV A

(1) Type II Fibrous felt or glass fiber mat membrane on both major surfaces of the core foam.

2.1.1 Thermal Resistance

As indicated on drawings.

2.1.2 Fire Protection Requirements

- a. Flame spread index of 75 or less when tested in accordance with ASTM E84.
- b. Smoke developed index of 450 or less when tested in accordance with ASTM E84.
- c. Provide insulated assemblies in accordance ICC IBC Chapter Fire and Smoke Protection Features.

2.1.3 Other Material Properties

Provide thermal insulating materials with the following properties:

- a. Rigid cellular plastics: Compressive Resistance at Yield: Not less than 10 pounds per square inch (psi) when measured according to ASTM D1621.
- b. Water Vapor Permeance: Not more than 1.1 Perms or less when measured according to ASTM E96/E96M, desiccant method, in the thickness required to provide the specified thermal resistance, including facings, if any.
- c. Water Absorption: Not more than 2 percent by total immersion, by volume, when measured according to ASTM C272/C272M.

2.1.4 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all other requirements of this section. The minimum required recycled material contents (by weight, not volume) are:

Polyisocyanurate/Polyurethane:	9 percent
Phenolic Rigid Foam:	5 percent
Perlite Board:	75 percent post consumer paper

Provide data identifying percentage of recycled content for block or board insulation.

2.1.5 Indoor Air Quality

Provide certification of VOC Emissions for block or board insulation.

2.1.6 Prohibited Materials

Do not provide materials containing asbestos.

2.2 Perimeter Insulation

Refer to specification 03 30 00, Cast in Place Concrete.

2.3 VAPOR BARRIER

Refer to 03 30 00, Cast-In-Place Concrete for specification on underslab vapor barrier.

Refer to 07 27 26, Fluid-Applied Membrane Air Barriers for specification on typical exterior wall vapor barrier.

2.4 PROTECTION BOARD OR COATING

As recommended by insulation manufacturer.

2.5 ACCESSORIES

2.5.1 Adhesive

As recommended by insulation manufacturer.

2.5.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Prior to installation, ensure all areas that are in contact with the insulation are dry and free of projections that could cause voids, compressed insulation, or punctured vapor retarders. For foundation perimeter or under slab applications, check that subsurface fill is flat, smooth, dry, and well tamped. Do not proceed with installation if moisture or other conditions are present, and notify the Contracting Officer of such conditions. Do not proceed with the work until conditions have been corrected and verified to be dry.

3.2 PREPARATION

3.2.1 Blocking Around Heat Producing Devices

Provide noncombustible blocking at all spaces between heat producing devices and the floors, ceilings and roofs through which they pass. Provide in accordance with ICC IBC Section 2111.12 Fireplace Blocking and with the following clearances:

- a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is placed above fixture or device, 24 inches above fixture.
- b. Vents and vent connectors used for venting products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.
- c. Gas Fired Appliances: Clearances as required in NFPA 54.
- d. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking is not required if chimneys or flues are certified in writing by the chimney or flue manufacturer for use in contact with specific insulating materials.

3.3 INSTALLATION

3.3.1 Installation and Handling

Provide insulation in accordance with the manufacturer's printed installation instructions. Keep material dry and free of extraneous materials.

3.3.2 Electrical Wiring

Do not install insulation in a manner that would enclose electrical wiring between two layers of insulation.

3.3.3 Cold Climate Requirement

Place insulation on the outside of pipes.

3.3.4 Continuity of Insulation

Butt tightly against adjoining boards, studs, rafters, joists, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating thermal bridges and voids. Provide and verify continuity of insulative barrier throughout the building enclosure.

3.3.5 Coordination

Verify final installed insulation thicknesses comply with thicknesses indicated, R-values specified herein, and with the approved insulation submittal(s).

3.4 INSTALLATION ON WALLS

3.4.1 Installation using Furring Strips

Install insulation on members as recommended by insulation manufacturer.

3.4.2 Installation on Masonry Walls

Apply board directly to masonry with adhesive or fasteners as recommended by the insulation manufacturer. Fit between obstructions without impaling board on ties or anchors. Apply in parallel courses with joints breaking midway over course below. Place boards in moderate contact with adjoining insulation without forcing and without gaps. Cut and shape as required to fit around wall penetrations, projections or openings to accommodate conduit or other utilities. Seal around cutouts with sealant. Install insulation in wall cavities so that it leaves at least a nominal 1 inch air space outside of the insulation to allow for cavity drainage.

3.4.3 Adhesive Attachment to Concrete and Masonry Walls

Apply adhesive to wall and completely cover wall with insulation.

- a. Full back bed method or
- b. Spot method: Provide at least six spots having diameter of approximately 4 inches, located at each corner and mid points of each of the longer sides of each board.
- c. As recommended by the insulation manufacturer.
- d. Use only full back method for pieces of 1 square foot or less.

3.4.4 Mechanical Attachment on Concrete and Masonry Walls

Cut insulation to cover walls. Apply adhesive to wall and set clip or other mechanical fastener in adhesive as recommended by manufacturer. After curing of adhesive, install insulation over fasteners and bend split prongs to provide a flush condition with the insulation.

3.4.5 Protection Board or Coating

Install protection board or coating in accordance with manufacturer's printed instructions. Install protection over all exterior exposed insulation and to 1 foot below grade.

3.5 INSTALLATION ON UNDERSIDE OF CONCRETE FLOOR SLAB

3.5.1 Mechanically Fastened Systems

Size insulation to cover underside of slab. Apply adhesive to slab and set fasteners in adhesive as recommended by manufacturer. After curing of adhesive, install insulation over fasteners and bend split prongs to provide a flush condition with the insulation.

3.5.2 Adhesively Bonded Systems

Apply adhesive to underside of slab and completely cover wall with insulation.

- a. Full back bed method or
- b. Spot method: Provide at least six spots having a diameter of approximately 4 inches, located at each corner and mid-point of each of the longer sides.
- c. As recommended by insulation manufacturer.
- d. Use full back method for insulation pieces 1 square foot or less.

3.6 PERIMETER AND UNDER SLAB INSULATION

Install perimeter thermal insulation where heated spaces are adjacent to exterior walls, slab edges in slab-on-grade, or floating slab construction.

3.6.1 Manufacturer's Instructions

Layout insulation, provide required accessories to protection against vermin, insects, and damage in accordance with manufacturer's printed instructions.

3.6.2 Insulation on Vertical Surfaces

Provide thermal insulation as indicated in drawings. Fasten insulation with adhesive or mechanical fasteners.

3.6.3 Insulation Under Slab

Provide insulation horizontally under slab on grade for a distances as indicated on drawings from edge of slab. Turn insulation up at slab edge, and extend full height of slab. Install insulation on top of vapor retarder and turn retarder up over the outside edge of insulation to top of slab.

3.6.4 Protection of Insulation

Protect insulation from damage during construction and back filling by application of protection board or a coating. Do not leave installed vertical insulation unprotected overnight. Protect installed insulation from weather, including rain and ultraviolet light, from mechanical abuse, compression, and dislocation. Install protection over entire exposed exterior insulation board.

3.7 ACCESS PANELS AND DOORS

Attach insulation to all access panels greater than 1 square foot and all access doors in insulated floors and ceilings. Use insulation with same R-Value as that for the floor or ceiling in which each panel occurs.

-- End of Section --

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SECTION 07 21 16

MINERAL FIBER BLANKET INSULATION

11/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C665	(2017) Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C930	(2019) Standard Classification of Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D5359	(2015) Standard Specification for Glass Cullet Recovered from Waste for Use in Manufacture of Glass Fiber
ASTM E136	(2019a) Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2020) Standard for the Installation of Oil-Burning Equipment
NFPA 54	(2021) National Fuel Gas Code
NFPA 211	(2019) Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134

Respiratory Protection

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Blanket Insulation

Accessories

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

SD-08 Manufacturer's Instructions

Insulation

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for insulation materials.

Provide regional material certifications of applicable materials.

1.3.3 IEQ Low Emitting Materials

For Insulation applied inside the weatherproofing system - submit statement indicating compliance with the;

a. VOC Emissions Evaluation.

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials to site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.4.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.5 SAFETY PRECAUTIONS

1.5.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.5.2 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C930.

PART 2 PRODUCTS

2.1 BLANKET INSULATION

ASTM C665, Type I, blankets without membrane coverings.

2.1.1 Recycled Materials

Provide insulation materials containing the following minimum percentage of recycled material content by weight:

Fiberglass: 20 percent glass cullet complying with ASTM D5359

Provide data identifying percentage of recycled content for insulation materials.

2.1.2 Prohibited Materials

Do not provide asbestos-containing materials.

2.1.3 Reduced Volatile Organic Compounds (VOC) for Insulation Materials

Provide certification of VOC emissions for insulation materials.

2.2 BLOCKING

Wood, metal, unfaced mineral fiber blankets in accordance with ASTM C665,

Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E136 for blocking around chimneys and heat producing devices.

2.3 ACCESSORIES

2.3.1 Adhesive

As recommended by the insulation manufacturer. Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of VOC emissions for adhesives.

2.3.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify Contracting Officer of such conditions.

3.2 PREPARATION

3.2.1 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

- a. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.
- b. Gas Fired Appliances: Clearances as required in NFPA 54.
- c. Oil Fired Appliances: Clearances as required in NFPA 31.

3.3 INSTALLATION

3.3.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Any materials that show visual evidence of biological growth due to presence of moisture must not be installed on the building project. Ensure personal protective clothing and respiratory equipment is used as

required. Observe safe work practices.

3.3.1.1 Electrical wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.3.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

3.3.1.3 Cold Climate Requirement

Place insulation to the outside of pipes.

3.3.1.4 Insulation without Affixed Vapor Retarder

Provide snug friction fit to hold insulation in place. Stuff pieces of insulation into cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, band joists, and headers.

3.3.1.5 Sizing of Blankets

Provide only full width blankets when insulating between trusses, joists, or studs. Size width of blankets for a snug fit where trusses, joists or studs are irregularly spaced.

-- End of Section --

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SECTION 07 22 00

ROOF AND DECK INSULATION

02/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C1177/C1177M (2017) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing

ASTM C1289 (2020) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

ASTM E84 (2020) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4450 (1989) Approval Standard for Class 1 Insulated Steel Deck Roofs

FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

UNDERWRITERS LABORATORIES (UL)

UL 1256 (2002; Reprint Jul 2013) Fire Test of Roof Deck Constructions

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Insulation Board Layout and Attachment; G

Verification of Existing Conditions; G

SD-03 Product Data

Insulation; G

Cover Board; G

Fasteners; G

SD-06 Test Reports

Flame Spread Rating; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

Installer Qualifications; G

SD-08 Manufacturer's Instructions

Nails and Fasteners; G

Roof Insulation; G

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for insulation materials.

Provide regional material certifications of applicable materials.

1.2.1.3 IEQ Low Emitting Materials

For Insulation applied inside the weatherproofing system - submit statement indicating compliance with the;

a. VOC Emissions Evaluation.

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.3 SHOP DRAWINGS

Submit insulation board layout and attachment indicating methods of attachment and spacing, transitions, tapered components, thicknesses of materials, and closure and termination conditions. Show locations of ridges, valleys, crickets, interface with, and slope to, roof drains. Base shop drawings on verified field measurements and include verification

of existing conditions.

1.4 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for cover board or coatings, and precautions for flammability and toxicity. Include data to verify compatibility of sealants with insulation.

1.5 MANUFACTURER'S INSTRUCTIONS

Include field of roof and perimeter attachment requirements.

Provide a complete description of installation sequencing for each phase of the roofing system. Include weatherproofing procedures.

1.6 QUALITY CONTROL

Provide certification of installer qualifications from the insulation manufacturer confirming the specific installer has the required qualifications for installing the specific roof insulation system(s) indicated.

1.7 FM APPROVAL REQUIREMENTS

Provide fastening patterns in accordance with FM 1-120 for insulation on steel decks.

1.8 FIRE PERFORMANCE REQUIREMENTS

1.8.1 Insulation in Roof Systems

Comply with the requirements of UL 1256. Roof insulation to have a flame spread rating of 75 or less when tested in accordance with ASTM E84. Additional documentation of compliance with flame spread rating is not required when insulation of the type used for this project as part of the specific roof assembly is listed and labeled as FM Class 1 approved.

1.9 DELIVERY, STORAGE, AND HANDLING

1.9.1 Delivery

Deliver materials to the project site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

- a. Name of manufacturer
- b. Brand designation
- c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification

Deliver materials in sufficient quantity to allow continuity of the work.

1.9.2 Storage and Handling

Store and handle materials in accordance with manufacturer's printed instructions. Protect from damage, exposure to open flame or other

ignition sources, wetting, condensation, and moisture absorption. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Replace damaged material with new material.

1.10 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 40 degrees F and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

Provide one of the following roof insulation materials. Provide roof insulation that is compatible with attachment methods for the specified insulation and roof membrane.

- a. Polyisocyanurate Board: Provide in accordance with ASTM C1289 REV A Type II, fibrous felt or glass mat membrane both sides, except minimum compressive strength of 20 pounds per square inch (psi).

2.1.2 Recycled Materials

Provide thermal insulation materials containing recycled content. Unless specified otherwise, the minimum required recycled content for listed materials are:

Perlite Composition Board:	75 percent postconsumer paper
Polyisocyanurate/polyurethane:	9 percent recovered material
Wood Fiberboard:	100 percent recovered material
Cellular Glass Insulation:	75 percent recovered content
Structural Fiberboard:	100 percent recovered content
Fiberglass Insulation:	25 percent recovered content
Fiber (felt) or Fiber composite:	75 percent recovered content
Rubber:	90 percent recovered content
Plastic or Plastic/Rubber composite:	90 percent recovered content
Wood/Plastic Composite:	90 percent total recovered content

Provide data identifying percentage of recycled content for insulation.

2.1.3 Indoor Air Quality

Provide certification of VOC emissions for insulation.

2.1.4 Insulation Thickness

As necessary to provide the thermal resistance (R-value) indicated for average thickness of tapered system. Base calculation on the R-value for aged insulation. For insulation over steel decks, satisfy both specified R-value and minimum thickness for width of rib opening recommended in insulation manufacturer's published literature.

2.1.5 Tapered Roof Insulation

One layer of the tapered roof insulation assembly must be factory tapered to a slope of not less than as indicated on drawings. Factory fabricate mitered joints from two diagonally cut boards or one board shaped to provide required slopes.

2.2 COVER BOARD

For use as a thermal barrier (underlayment), fire barrier (overlayment), or cover board for hot-mopped, torched-down, or adhesive-applied roofing membrane over roof insulation.

2.2.1 Glass Mat Gypsum Roof Board

ASTM C1177/C1177M, 0 Flame Spread and 0 Smoke Developed when tested in accordance with ASTM E84, 500 psi, Class A, non-combustible, 1/2 inch thick, 4 by 8 feet board size.

2.3 FASTENERS

Provide flush-driven fasteners through flat round or hexagonal steel or plastic plates. Provide zinc-coated steel plates, flat round not less than 1 3/8 inch diameter, hexagonal not less than 28 gage. Provide high-density plastic plates, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 3 inches in diameter. Fully recess fastener head into plastic plate after it is driven. Form plates to prevent dishing. Do not use bell or cup shaped plates. Provide fasteners in accordance with insulation manufacturer's recommendations for holding power when driven, or a minimum of 120 pounds each in steel deck, whichever is the higher minimum.

2.3.1 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws in accordance with FM 4450 and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand a minimum uplift pressure as indicated on drawings in accordance with FM APP GUIDE.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Ensure surfaces are clean, smooth, and dry prior to application. Check roof deck surfaces, including surfaces sloped to roof drains and outlets,

for defects before starting work.

The Contractor must inspect and approve the surfaces immediately before starting installation. Prior to installing insulation, perform the following:

- a. Examine steel decks to ensure that panels are properly secured to structural members and to each other and that surfaces of top flanges are flat or slightly convex.

3.1.2 Surface Preparation

Correct defects and inaccuracies in roof deck surface to eliminate poor drainage from hollow or low spots, perform the following:

- a. Provide wood nailers of the same thickness as the insulation at eaves, edges, curbs, walls, and roof openings for securing of cant strips, gravel stops, gutters, and flashing flanges.
- b. Cover steel decks with a layer of insulation board of sufficient width to span the width of a deck rib opening, and in accordance with fire safety requirements. Secure with piercing or self-drilling, self-tapping fasteners of quantity and placement in accordance with FM APP GUIDE. Locate insulation joints parallel to ribs of deck on solid bearing surfaces only, not over open ribs.

3.2 INSULATION INSTALLATION

Apply insulation in two layers with staggered joints when total required thickness of insulation exceeds 1/2 inch. Lay insulation so that continuous longitudinal joints are perpendicular to direction of roofing, as specified in Section 07 52 00, Modified Bituminous Membrane roofing and 07 41 13, Metal Roof Panels, and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, provide joints of each succeeding layer that are parallel and offset in both directions with respect to the layer below. Keep insulation 1/2 inch clear of vertical surfaces penetrating and projecting from roof surface. Verify required slopes to each roof drain.

3.2.1 Installation Using Only Mechanical Fasteners

Secure total thickness of insulation with penetrating type fasteners.

3.2.2 Special Precautions for Installation of Foam Insulation

3.2.2.1 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install 1/2 inch thick wood fiberboard, glass mat gypsum roof board, or 3/4 inch thick expanded perlite board insulation over top surface of foam board insulation. Stagger joints of insulation with respect to foam board insulation below.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with finished roofing specified in 07 52 00, Modified Bituminous Membrane roofing and

07 41 13, Metal Roof Panels on same day. Phased construction is not permitted. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces is not permitted. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight in accordance with indicated live load limits of roof construction. Protect exposed edges of insulation with cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs must be two layers of bituminous-saturated felt set in plastic bituminous cement or single ply set in roof cement. Fill all profile voids in cutoffs to prevent trapping moisture below the membrane. Remove cutoffs when work resumes.

3.3.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

3.4 INSPECTION

Establish and maintain inspection procedures to assure compliance of the installed roof insulation with contract requirements. Remove, replace, correct in an approved manner, any work found not in compliance. Quality control must include, but is not limited to, the following:

- a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.
- b. Verification of certification, listing or label compliance with FM Data Sheets. (
<https://www.fmglobal.com/fmglobalregistration/Downloads.aspx>)
- c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.
- d. Inspection of mechanical fasteners; type, number, length, and spacing.
- e. Coordination with other materials, cants, sleepers, and nailing strips.
- f. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.
- g. Installation of cutoffs and proper joining of work on subsequent days.
- h. Continuation of complete roofing system installation to cover insulation installed same day.
- i. Verification of required slope to each roof drain.

-- End of Section --

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SECTION 07 27 10.00 10

BUILDING AIR BARRIER SYSTEM
08/19, CHG 1: 02/20

PART 1 GENERAL

1.1 SUMMARY

This Section specifies the construction and quality control of the installation of an air barrier system. Construct the air barrier system indicated, taking responsibility for the means, methods, and workmanship of the installation of the air barrier system. The air barrier must be contiguous and connected across all surfaces of the enclosed air barrier envelope indicated. The maximum leakage requirements of individual air barrier components and materials are specified in the other specification sections covering these items.

This section also defines the maximum allowable leakage of the final air barrier system. The workmanship must be adequate to meet the maximum allowable leakage requirements of this specification. Test the assembled air barrier system to demonstrate that the building envelope is properly sealed and insulated. Passing the air barrier system leakage test and thermography test will result in system acceptance. Conform air barrier system leakage and thermography testing and reporting to the requirements of Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referenced within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM E96/E96M	(2021) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E2178	(2013) Standard Test Method for Air Permeance of Building Materials
ASTM E2357	(2017) Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies
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Containing Combustible Components

1.3 DEFINITIONS

The following terms as they apply to this section:

1.3.1 Air Barrier Accessory

Products designated to maintain air tightness between air barrier materials, air barrier assemblies and air barrier components, to fasten them to the structure of the building, or both (e.g., sealants, tapes, backer rods, transition membranes, fasteners, strapping, primers).

1.3.2 Air Barrier Assembly

The combination of air barrier materials and air barrier accessories that are designated and designed within the environmental separator to act as a continuous barrier to the movement of air through the environmental separator.

1.3.3 Air Barrier Component

Pre-manufactured elements such as windows, doors, dampers and service elements that are installed in the environmental separator.

1.3.4 Air Barrier Envelope

The combination of air barrier assemblies and air barrier components, connected by air barrier accessories that are designed to provide a continuous barrier to the movement of air through an environmental separator. There may be more than one air barrier envelope in a single building. Also known as Air Barrier System.

1.3.5 Air Barrier Material

A building material that is designed, tested and/or produced to provide the primary resistance to airflow through an air barrier assembly of a wall system.

1.3.6 Air Barrier System

Same as AIR BARRIER ENVELOPE.

1.3.7 Air Leakage Rate

The rate of airflow (CFM) driven through a unit surface area (sq.ft.) of an assembly or system by a unit static pressure difference (Pa) across the assembly. (example: 0.25 CFM/sq.ft. @ 75 Pa)

1.3.8 Air Leakage

The total airflow (CFM) driven through the air barrier system by a unit static pressure difference (Pa) across the air barrier envelope. (example: 6500 CFM @ 75 Pa)

1.3.9 Air Permeance

The tested rate of airflow (CFM) through a unit area (sq.ft.) of a material driven by unit static pressure difference (Pa) across the

material (example: 0.004 CFM/sq.ft. @ 75 Pa) as established by ASTM E2178.

1.3.10 Environmental Separator

The parts of a building that separate the controlled interior environment from the uncontrolled exterior environment, or that separate spaces within a building that have dissimilar environments. Also known as the Control Layer.

1.3.11 Vapor Permeance

Vapor permeance is separated into three classes based on the water vapor permeance of a material as tested via ASTM E96/E96M

Class I Vapor Barrier/Retarder 0.1 perm or less

Class II Vapor Barrier/Retarder 0.1 perm to 1.0 perm

Class III Vapor Barrier/Retarder 1.0 perm to 10 perm

1.4 PREPARATORY PHASE OR PRECONSTRUCTION CONFERENCE

Organize pre-construction conferences between the air barrier inspector and the sub-contractors involved in the construction of or penetration of the air barrier system to discuss where the work of each sub-contractor begins and ends, the sequence of installation, and each sub-contractor's responsibility to ensure airtight joints, junctures, penetrations and transitions between materials. Discuss the products, and assemblies of products specified in the different sections to be installed by the different sub-contractors.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Air Barrier System Shop Drawings; G, Manufacturer produced warranted air barrier system

SD-03 Product Data

Air Barrier System Product Data; G

SD-04 Samples

Mock-Up; G

Material Samples For Air Barrier System; G

SD-05 Design Data

Design Data And Calculations For The Air Barrier System; G, Manufacturer produced warranted air barrier system

SD-06 Test Reports

Design Review Report; G

Testing and Inspection; G

SD-07 Certificates

EPD(s); S

Air Barrier Inspector; G

1.5.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.5.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.5.1.2 IEQ Low-Emitting Materials

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

1.6 AIR BARRIER ENVELOPE SURFACE AREA AND LEAKAGE REQUIREMENTS

The building air barrier systems must meet the following leakage requirements. The allowable leakage rate and the maximum leakage are at a differential test pressure of 75 Pa.

See drawing A-010 for Air Barrier Calculations.

1.7 AIR BARRIER INSPECTOR

Employ a designated Air Barrier Inspector on this project. The Air Barrier Inspector performs a Design Review, oversees quality control testing specified in these specifications, performs quality control air barrier inspection as specified, interfaces with the designer and product manufacturer's representatives to assure all installation requirements are met, and verifies that the constructed work is in accordance with both the manufacturer's recommendations for products used, the content of this specification and other contract drawings or documents. Qualification for the Air Barrier Inspector are as follows:

- a. Training and certification as an Air Barrier Auditor from the Air Barrier Association of America (ABAA) or other third party air barrier association.
- b. Or, provide documentation in resume format that demonstrates that the individual proposed has the experience, knowledge, skills and abilities to fulfill the above stated duties as the air barrier inspector.
- c. It is acceptable that this individual be employed by the firm who will

be performing the building pressurization test or another independent third party entity, provided they meet the above requirements but shall not be a member of the installing contractor or firm.

Provide copies of Air Barrier Inspector qualifications 30 days after Notice to Proceed.

1.8 DESIGN REVIEW

Review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the construction of an effective air barrier system. Provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper air barrier system. Provide copies of the Design Review Report not later than 14 days after approval of the Air Barrier Inspector Qualifications. Submit design data and calculations for the Air Barrier System for a manufacturer produced warranted air barrier system.

PART 2 PRODUCTS

2.1 AIR BARRIER

Provide air barrier system of compatible parts from one or several manufacturers coordinated by the contractor or provide a single warranted system provided by a primary manufacturer. The air barrier system as part of a tested exterior wall assembly must meet the conditions of acceptance as tested in accordance with NFPA 285. Materials used for roof assembly air barrier must conform to the appropriate UL and FM wind and fire requirements for the specified roof assemblies.

If a complete air barrier system from a single manufacturer is utilized, whether warranted or not warranted, the air barrier system must conform to ASTM E2357.

Materials in the following categories as used in the air barrier system or assembly of the exterior wall system are tested and are required to conform to ASTM E2178: Self-adhered sheet membranes, fluid applied membranes, spray polyurethane foam, mechanically fastened commercial building wrap, factory bonded membranes to sheathing, and adhesive backed commercial building wrap and accessory products.

Other materials used as an air barrier such as concrete, glass, wood, metal or gypsum board may or may not conform to ASTM E2178 but are acceptable provided that when integrated into the air barrier system or assemblies that they are not subject to material or environmental induced degradation in their final produced state and once incorporated in the permanent construction.

All materials used must be identifiable through manufacturer testing data and/or literature to be compatible with all the attached or adjoining materials or substrates used in the system.

Provide Air Barrier System Shop Drawings, Material Samples for Air Barrier System and Air Barrier System Product Data.

PART 3 EXECUTION

3.1 QUALITY CONTROL

3.1.1 Documentation and Reporting

Document the entire installation process on daily job site reports. These reports include information on the Installer, substrates, substrate preparation, products used, ambient and substrate temperature, the location of the air barrier installation, the results of the quality control procedures, and testing results.

3.1.2 Construction Mock-Up

Build mock-up prior to building envelope construction.

- a. Prepare a construction mock-up to demonstrate proper installation of the air barrier assemblies and components. Include air barrier system connections between floor and wall, wall and window, wall and roof. Also, include the sealing method between membrane joints at transitions from one material or component to another, at pipe or conduit penetrations of the wall and roof, and at duct penetration of the wall and roof. Work will not begin until the mock-up is satisfactory to the Contracting Officer.
- b. Size the mock-up to approximately 8 feet long by 8 feet high. The mock-up must be representative of primary exterior wall assemblies and glazing components including backup wall and typical penetrations as acceptable to the Contracting Officer. A corner of the actual building may be used as the mock-up.
- c. Mock-Up Tests for Adhesion: Test the mock-up of materials for adhesion in accordance with manufacturer's recommendations. Perform the test after the curing period recommended by the manufacturer. Record the mode of failure and the area which failed in accordance with ASTM D4541. When the air barrier material manufacturer has established a minimum adhesion level for the product on the particular substrate, the inspection report must indicate whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product/substrate combination, simply record the value.

3.1.3 Quality Control Testing And Inspection

Conduct the following tests and inspections as applicable in the presence of the Contracting Officer during installation of the air barrier system, and submit quality control reports as indicated below.

- a. Provide a Daily Report of Observations with a copy to the Contracting Officer.
- b. Inspect to assure continuity of the air barrier system throughout the building enclosure and that all gaps are covered, the covering is structurally sound, and all penetrations are sealed allowing for no infiltration or exfiltration through the air barrier system.
- c. Inspect to assure structural support of the air barrier system to withstand design air pressures.

- d. Inspect to assure masonry surfaces receiving air barrier materials are smooth, clean, and free of cavities, protrusions and mortar droppings, with mortar joints struck flush or as required by the manufacturer of the air barrier material.
- e. Inspect and test to assure site conditions for application temperature, and dryness of substrates are within guidelines.
- f. Inspect to assure substrate surfaces are properly primed if applicable and in accordance with manufacturer's instructions. Priming must extend at least 2 inches beyond the air barrier material to make it obvious that the primer was applied to the substrate before the air barrier material.
- g. Inspect to assure laps in materials are at least a 2-inch minimum, shingled in the correct direction or mastic applied in accordance with manufacturer's recommendations, and with no fishmouths.
- h. Inspect to assure that a roller has been used to enhance adhesion. Identify any defects such as fishmouths, wrinkles, areas of lost adhesion, and improper curing. Note the intended remedy for the deficiencies.
- i. Measure application thickness of liquid applied materials to assure that manufacturer's specifications for the specific substrate are met.
- j. Inspect to assure that the correct materials are installed for compatibility.
- k. Inspect to assure proper transitions for change in direction and structural support at gaps.
- l. Inspect to assure proper connection between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.
- m. Perform adhesion tests for fluid-applied and self-adhered air barrier membranes to assure that the manufacturer's specified adhesion strength properties are met. Determine the bond strength of coatings to substrate in accordance with ASTM D4541.
- n. Provide cohesion tests for spray polyurethane foam (SPF). Perform the tests in accordance with the specification sections which specify these materials.
- o. Provide written test reports of all tests performed.

3.2 REPAIR AND PROTECTION

Upon completion of inspection, testing, sample removal and similar services, repair damaged construction and restore substrates, coatings and finishes. Protect construction exposed by or for quality control service activities, and protect repaired construction.

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SECTION 07 27 19.01

SELF-ADHERING AIR BARRIERS

05/17, CHG 2: 08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)

ABAA Accreditation

Accreditation

ABAA QAP

Quality Assurance Program

ASTM INTERNATIONAL (ASTM)

ASTM D146/D146M

(2004; E 2012; R 2012) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing

ASTM D412

(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D570

(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics

ASTM D903

(1998; R 2017) Standard Test Method for Peel or Stripping Strength of Adhesive Bonds

ASTM D1876

(2008; R 2015; E 2015) Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)

ASTM D4263

(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

ASTM D4541

(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM E84

(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E96/E96M

(2021) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials

ASTM E154/E154M

(2008a; R 2013; E 2013) Water Vapor Retarders Used in Contact with Earth Under

Concrete Slabs, on Walls, or as Ground
Cover

- ASTM E283 (2019) Standard Test Method for
Determining the Rate of Air Leakage
Through Exterior Windows, Curtain Walls,
and Doors Under Specified Pressure
Differences Across the Specimen
- ASTM E331 (2000; R 2016) Standard Test Method for
Water Penetration of Exterior Windows,
Skylights, Doors, and Curtain Walls by
Uniform Static Air Pressure Difference
- ASTM E2178 (2013) Standard Test Method for Air
Permeance of Building Materials
- ASTM E2357 (2017) Standard Test Method for
Determining Air Leakage of Air Barrier
Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 285 (2012) Standard Fire Test Method for
Evaluation of Fire Propagation
Characteristics of Exterior
Non-Load-Bearing Wall Assemblies
Containing Combustible Components

1.2 RELATED REQUIREMENTS

Coordinate the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS and other building enclosure sections to provide a complete building air barrier system. Submit all materials, components, and assemblies of the air barrier system together as one complete submittal package.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications of Manufacturer; G

Qualifications of Installer; G

Manufacturer's Technical Representative; G

SD-02 Shop Drawings

Self-adhering Air Barrier; G

SD-03 Product Data

Self-adhering Air Barrier; G

Primers, Adhesives, and Mastics; G

Safety Data Sheets

SD-04 Samples

Self-adhering Air Barrier Mockup; G

SD-06 Test Reports

Field Peel Adhesion Test; G

Flame Propagation of Wall Assemblies; G

Flame Spread and Smoke Developed Index Ratings; G

Site Inspections and Testing; G

SD-07 Certificates

Self-adhering Air Barrier; G

EPD(s); S

Recycled Content; S

Regional Material; S

SD-08 Manufacturer's Instructions

Self-adhering Air Barrier; G

Primers, Adhesives, and Mastics; G

SD-09 Manufacturer's Field Reports

Manufacturer's Field Inspection Reports; G

1.4 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.4.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.4.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of applicable materials.

Provide regional material certifications of applicable materials.

1.4.3 IEQ Low Emitting Materials

For Paints and Coatings applied on site refer to specification section

09 90 00 for low-emitting requirements.

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.5 MISCELLANEOUS REQUIREMENTS

For self-adhering air barrier provide the following:

1.5.1 Shop Drawings

Submit self-adhering air barrier shop drawings showing locations and extent of air barrier assemblies and details of all typical conditions, intersections with other building enclosure assemblies and materials, and membrane counterflashings. Show details for bridging of gaps in construction, treatment of inside and outside corners, expansion joints, methods of attachment of materials covering the self-adhered barrier without compromising the barrier. Indicate how miscellaneous penetrations such as conduit, pipes, electric boxes, brick ties, and similar items will be sealed.

1.5.2 Product Data

Submit manufacturer's technical data indicating compliance with performance and environmental requirements, manufacturer's printed instructions for evaluating, preparing, and treating substrates, temperature and other limitations of installation conditions, safety requirements for installation, and Safety Data Sheets. Indicate flame and smoke spread ratings for all products.

1.5.3 Mockup

Provide a mockup of the self-adhering air barrier system specified. Apply product in an area designated by the Contracting Officer. Apply an area of not less than 54 square feet. Include all components specified as representative of the complete system. Notify the Contracting Officer a minimum of 48 hours prior to the test application. Select a test area representative of conditions to be covered including window or door openings, wall to ceiling transitions, flashings, and penetrations, as applicable.

1.5.4 Test Reports

Submit test reports indicating that field peel-adhesion tests on all materials have been performed and the changes made, if required, in order to achieve successful and lasting adhesion. Submit test reports for flame propagation of wall assemblies tested in accordance with NFPA 285. Submit test reports for flame spread and smoke developed index ratings of barrier system materials tested in accordance with ASTM E84.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Deliver and store materials in sufficient quantity to allow for uninterrupted flow of work. Inspect materials delivered to the site for damage and store out of weather. Deliver materials to the jobsite in their original unopened packages, clearly marked with the manufacturer's name, brand designation, description of contents, and shelf life of

containerized materials. Store and handle to protect from damage.

1.6.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Protect stored materials from direct sunlight. Keep materials sealed and separated from absorptive materials, such as wood and insulation.

1.7 FIELD PEEL ADHESION TEST

Perform a field peel-adhesion test on the construction mockup. Test the self-adhering air barrier for adhesion in accordance with ASTM D4541 using a Type II pull tester except use a disk that is 4 inches in diameter and cut through the membrane to separate the material attached to the dish from the surrounding material. Perform test after curing period in accordance with manufacturer's written recommendations. Record mode of failure and area which failed in accordance with ASTM D4541. Compare adhesion values with the manufacturer's established minimum values for the particular combination of material and substrate. Indicate on the inspection report whether the manufacturer's requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product and substrate combination, the inspector must record actual values.

1.8 AIR BARRIER TESTING

Perform air barrier testing in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM and Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.

1.9 QUALITY ASSURANCE

1.9.1 Qualifications of Manufacturer

Submit documentation verifying that the manufacturer of the self-adhering air barrier is currently accredited by Air Barrier Association of America (ABAA Accreditation <https://www.airbarrier.org/>).

1.9.1.1 Manufacturer's Technical Representative

The manufacturer's technical representative must be thoroughly familiar with the products to be installed, installation requirements and practices, and with any special considerations in the geographical area of the project. The representative must perform field inspections and attend meetings as specified. The representative must provide field inspection reports.

1.9.2 Qualifications of Installer

Submit documentation verifying that installers of the self-adhering air barrier are currently certified in accordance with the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>).

1.10 PRECONSTRUCTION MEETING

Conduct a preconstruction meeting a minimum of two weeks prior to commencing work specified in this Section. Agenda must include, at a

minimum, construction and testing of mockup, sequence of construction, coordination with substrate preparation, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction. Attendance is required by representatives of related trades including covering materials, substrate materials, adjacent materials, and materials and components of the air barrier system.

1.11 ENVIRONMENTAL CONDITIONS

1.11.1 Temperature

Install air barrier within the range of ambient and substrate temperatures as recommended in writing by the air barrier manufacturer. Verify that the surface to receive self-adhering air barrier is dry for a minimum of 48 hours prior to the installation of the barrier. Do not apply air barrier to damp or wet substrates. Do not apply during inclement weather or when ice, frost, surface moisture, or visible dampness is present on surfaces to be covered, or when precipitation is imminent.

1.11.2 Exposure to Weather and Ultraviolet Light

Protect air barrier products from direct exposure to rain, snow, sunlight, mist, and other extreme weather conditions. Replace, at no additional cost to the government, barrier products that have been exposed to ultraviolet (sun)light longer than allowed by manufacturer's written requirements.

PART 2 PRODUCTS

2.1 SELF ADHERING AIR BARRIER

Provide minimum 0.040 inch thick self-adhering, vapor retarding, air barrier membrane consisting of a cross-laminated high density polyethylene (HDPE) film, fully coated with rubberized asphalt adhesive. Provide membrane in rolls of various widths interleaved with disposable silicone release paper. Self-adhering air barrier must exhibit no visible water leakage when tested in accordance with ASTM E331 and must perform as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Use regular or low temperature formulation depending on site conditions, within temperature ranges specified by manufacturer.

2.1.1 Physical Properties

- a. Air Permeance (ASTM E2178): In accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM
- b. Air Leakage (ASTM E2357, ASTM E283): In accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM and Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.
- c. Tensile Strength (ASTM D412 die C modified): Not less than 400 psi.
- d. Tensile Elongation (ASTM D412 die C modified): Not less than 200 percent.
- e. Puncture Resistance (ASTM E154/E154M): Not less than 40 lbs.

- f. Pliability (ASTM D146/D146M): Unaffected at minus 25 degrees F, 0.063 inch mandrel.
- g. Lap Adhesion (ASTM D1876 modified): Not less than 4.0 lbs per inch.
- h. Peel Adhesion (ASTM D903): Not less than 5.0 lbs per inch.
- i. Water Vapor Permeance (Vapor Impermeable Air Barrier) (ASTM E96/E96M, desiccant method A): 0.1 perms or less.
- j. Water Absorption (ASTM D570): Not to exceed 0.12 percent by weight.
- k. Flame propagation of wall assemblies (NFPA 285): Pass
- l. Surface Burning Characteristics (ASTM E84):
 - (1) Flame Spread Index Rating not higher than 75.
 - (2) Smoke Developed Index Rating not higher than 150.

2.2 PRIMERS, ADHESIVES, AND MASTICS

Provide primers, adhesives, mastics and other accessory materials as recommended in writing by the manufacturer of the self-adhering air barrier for adequate bonding to each type of substrate.

2.3 SHEET METAL FLASHING

Provide as specified in Section 07 60 00 FLASHING AND SHEET METAL.

2.4 JOINT SEALANTS

Provide as specified in Section 07 92 00 JOINT SEALANTS. Verify compatibility with adjacent products that are or will be in contact with one another.

PART 3 EXECUTION

3.1 EXAMINATION

Before installing air barrier, examine substrates, areas, and conditions under which air barrier assemblies will be applied, with Installer present, for compliance with requirements. Ensure the following conditions are met:

- a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants.
- b. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
- c. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263 and take suitable measures until substrate passes moisture test.
- d. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel adhesion test on materials to which sealants are adhered.

3.2 PREPARATION

Clean, prepare, and treat substrate in accordance with manufacturer's written instructions. Ensure clean, dust-free, and dry substrate for air barrier application.

- a. Prime masonry and concrete substrates with conditioning primer.
- b. Prime gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
- c. Prime wood, metal, and painted substrates with primer.
- d. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier and at protrusions.

3.3 INSTALLATION

3.3.1 Installation of Self-adhering Air Barrier

Install materials in accordance with manufacturer's recommendations and the following:

- a. Apply primer at rate recommended by manufacturer prior to membrane installation. Allow primer to dry completely before membrane application. Apply as many coats as necessary for proper adhesion.
- b. When membrane is properly positioned, press into place and roll membrane with roller immediately after placement.
- c. Apply membrane sheets to shed water naturally without interception by a sheet edge, unless that edge is sealed with permanently flexible termination mastic.
- d. Position subsequent sheets of membrane applied above so that membrane overlaps the membrane sheet below by a minimum of 2-1/2 inches, unless greater overlap is recommended by manufacturer. Roll into place with roller.
- e. Make all side laps a minimum of 2-1/2 inches and all end laps a minimum of 5 inches, unless greater overlap is recommended by manufacturer. Roll seams with roller.
- f. Roll membrane to adhere to substrate. Cover corners and joints with two layers of reinforcement by first applying a 12 inch width of membrane centered along the axis. Flash drains and projections with a second ply of membrane for a distance of 6 inches from the drain or projection.
- g. Seal around all penetrations through the air barrier resulting from pipes, vents, conduit, electrical fixtures, structural members, or other construction passing through it. Seal with termination mastic, extruded silicone sealant, membrane counterflashing or other sealing methods in accordance with manufacturer's written recommendations.
- h. Continuously connect the air barrier between walls, roof, floor and below grade assemblies to form a continuous integrated air barrier system around the entire building enclosure. Extend the air barrier

membrane into rough openings such as doors, windows, louvers, and other exterior penetrations. Seal edges of barrier at junctures with rough openings.

- i. At changes in substrate plane, provide transition material (e.g. bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
- j. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Continuously support membrane with substrate.
- k. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
- l. At expansion and seismic joints provide transition to the joint assemblies.
- m. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer.
- n. At end of each working day, seal top edge of membrane to substrate with termination mastic.
- o. Do not allow materials to come in contact with chemically incompatible materials.
- p. Counterflash upper edge of thru-wall flashing and air barrier. Counter flashing and thru-wall flashing are specified in Section 07 60 00 FLASHING AND SHEET METAL.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Inspections and Testing

Provide site inspections and testing in accordance with ABAA protocol to verify conformance with the manufacturer's instructions, the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>), Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM,, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS, and this section.

- a. Conduct inspections and testing at 5, 50, and 95 percent completion of this scope of work. Forward written site inspections and testing reports to the Contracting Officer within five working days of the inspection and test being performed.
- b. If inspections reveal any defects, promptly remove and replace defective work at no additional expense to the Government.

3.5 FIELD PEEL ADHESION TEST

Conduct in accordance with test protocol indicated in Part 1, paragraph FIELD PEEL ADHESION TEST.

3.6 PROTECTION AND CLEANING

3.6.1 Protection

3.6.1.1 Adjacent Surfaces

Protect exposed adjacent surfaces that could be damaged by primers and adhesives associated with air barrier membrane. Provide protection during application and the remainder of construction in accordance with manufacturer's written instructions.

3.6.1.2 The Air Barrier Assembly

Protect finished portions of the air barrier assembly from damage during ongoing application and throughout the remainder of the construction period in accordance with manufacturer's written instructions. Coordinate timing of installation of materials that will cover the air barrier membrane to ensure the exposure period does not exceed that recommended by the air barrier manufacturer's written installation instructions. Remove and replace, at no additional cost to the government, membrane products that exceed the manufacturer's allowed exposure limits.

3.6.2 Cleaning

Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and as acceptable to the primary material manufacturer.

-- End of Section --

SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIERS

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)

ABAA Accreditation

Accreditation

ABAA QAP

Quality Assurance Program

ASTM INTERNATIONAL (ASTM)

ASTM C836/C836M

(2015) High Solids Content, Cold
Liquid-Applied Elastomeric Waterproofing
Membrane for Use With Separate Wearing
Course

ASTM D412

(2016) Standard Test Methods for
Vulcanized Rubber and Thermoplastic
Elastomers - Tension

ASTM D4263

(1983; R 2018) Standard Test Method for
Indicating Moisture in Concrete by the
Plastic Sheet Method

ASTM D4541

(2017) Standard Test Method for Pull-Off
Strength of Coatings Using Portable
Adhesion Testers

ASTM D5590

(2000; R 2010; E 2012) Standard Test
Method for Determining the Resistance of
Paint Films and Related Coatings to Fungal
Defacement by Accelerated Four-Week Agar
Plate Assay

ASTM E84

(2020) Standard Test Method for Surface
Burning Characteristics of Building
Materials

ASTM E96/E96M

(2021) Standard Test Methods for
Gravimetric Determination of Water Vapor
Transmission Rate of Materials

ASTM E283

(2019) Standard Test Method for
Determining the Rate of Air Leakage
Through Exterior Windows, Curtain Walls,
and Doors Under Specified Pressure
Differences Across the Specimen

ASTM E331	(2000; R 2016) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E2178	(2013) Standard Test Method for Air Permeance of Building Materials
ASTM E2357	(2017) Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components
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1.2 RELATED REQUIREMENTS

Coordinate the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS, and other building enclosure sections to provide a complete building air barrier system. Submit all materials, components and assemblies of the air barrier system together as one complete submittal package.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications of Manufacturer; G

Qualifications of Installer; G

SD-02 Shop Drawings

Fluid-Applied Membrane Air Barrier; G

SD-03 Product Data

Fluid-Applied Membrane Air Barrier; G

Transition Membrane; G

Primers, Adhesives, and Mastics; G

Reinforcement; G

Safety Data Sheets; G

SD-04 Samples

Fluid-Applied Membrane Air Barrier Mockup; G

SD-06 Test Reports

Capillary Moisture Test

Field Peel Adhesion Test

Flame Propagation of Wall Assemblies

Flame Spread and Smoke Developed Index Ratings

Site Inspections Reports

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

Fluid-Applied Membrane Air Barrier

Transition Membrane

SD-08 Manufacturer's Instructions

Fluid-Applied Membrane Air Barrier; G

Transition Membrane; G

Primers, Adhesives, and Mastics; G

1.4 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.4.1 M&R Environmental Product Declaration (EPD)

)Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.4.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of applicable materials.

Provide regional material certifications of applicable materials.

1.4.3 IEQ Low Emitting Materials

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.5 MISCELLANEOUS REQUIREMENTS

For fluid-applied membrane air barriers provide the following:

1.5.1 Shop Drawings

Submit fluid-applied membrane air barrier shop drawings showing locations and extent of barrier assemblies, transition membranes, details of all typical conditions, intersections with other envelope assemblies and materials, and membrane counterflashings. Show details for bridging of gaps in construction, treatment of inside and outside corners, expansion joints, methods of attachment of materials covering the self-adhered barrier without compromising the barrier. Indicate how miscellaneous penetrations such as conduit, pipes, electric boxes, brick ties, and similar items will be sealed.

1.5.2 Product Data

Submit manufacturer's technical data indicating compliance with performance and environmental requirements, manufacturer's printed instructions for evaluating, preparing, and treating substrates, temperature and other limitations of installation conditions, safety requirements for installation, and Safety Data Sheets. Indicate flame and smoke spread ratings for all products.

1.5.3 Mockup

Provide a mockup of the fluid-applied membrane air barrier. Apply product in an area designated by the Contracting Officer. Apply an area of not less than 54 square feet. Include all components specified as representative of the complete system. Notify the Contracting Officer a minimum of 48 hours prior to the test application. Select a test area representative of conditions to be covered including window or door openings, wall to ceiling transitions, flashings, and penetrations, as applicable.

1.5.4 Test Reports

Submit test reports indicating that capillary moisture tests and field peel adhesion tests on all substrate materials have been performed and the changes made, if required, in order to achieve successful and lasting adhesion. Submit test reports for flame propagation of wall assemblies tested in accordance with NFPA 285. Submit test reports for flame spread and smoke developed index ratings of barrier materials tested in accordance with ASTM E84.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Deliver and store materials in sufficient quantity to allow for uninterrupted flow of work. Inspect materials delivered to the site for damage and store out of weather. Deliver materials to the jobsite in their original unopened packages, clearly marked with the manufacturer's name, brand designation, description of contents, and shelf life of containerized materials. Store and handle to protect from damage.

1.6.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Protect stored materials from direct sunlight.

1.7 CAPILLARY MOISTURE TEST

Perform a capillary moisture test by plastic sheet method in accordance with ASTM D4263 on the construction mockup and substrate materials. Perform test after curing period as recommended by the air barrier manufacturer. Record mode of failure and area which failed in accordance with ASTM D4263. Once the air barrier material manufacturer has established a minimum adhesion or moisture level for the product on the particular substrate, indicate on the inspection report whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion or moisture value for their product and substrate combination, the inspector must record actual values.

1.8 FIELD PEEL ADHESION TEST

Perform a field peel adhesion test on a construction mockup. Test the applied product for adhesion in accordance with manufacturer's recommendations. Perform test after curing period recommended by the manufacturer. Record mode of failure and area which failed in accordance with ASTM D4541. When the manufacturer has established a minimum adhesion level for the product on the particular substrate, the inspection report must indicate whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product/substrate combination, the inspector must record actual values.

1.9 AIR BARRIER TESTING

Perform air barrier testing in accordance with Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.

1.10 QUALITY ASSURANCE

1.10.1 Qualifications of Manufacturer

Submit documentation verifying that manufacturer of fluid-applied membrane air barrier is currently accredited by the Air Barrier Association of America (ABAA Accreditation <https://www.airbarrier.org/>).

1.10.2 Qualifications of Installer

Submit documentation verifying that installers of the fluid-applied membrane air barrier are currently certified in accordance with the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>).

1.11 PRECONSTRUCTION MEETING

Conduct a preconstruction meeting a minimum of two weeks prior to commencing work specified in this Section. Agenda must include, at a minimum, construction and testing of construction mock up, sequence of construction, coordination with substrate preparation, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction. Attendance

is required by representatives of related trades including covering materials, substrate materials, adjacent materials, and materials and components of the fluid-applied membrane air barrier.

1.12 ENVIRONMENTAL CONDITIONS

1.12.1 Temperature

Install fluid-applied membrane air barrier within the range of ambient and substrate temperatures as recommended in writing by the fluid-applied membrane air barrier manufacturer. Do not apply fluid-applied membrane air barrier to a damp or wet substrate. Do not apply during inclement weather or when ice, frost, surface moisture, or visible dampness is present on surfaces to be covered, or when precipitation is imminent.

1.12.2 Exposure to Weather

Protect fluid-applied membrane air barrier products from direct exposure to rain, snow, sunlight, mist, and other extreme weather conditions. Replace, at no additional cost to the government, barrier products that have been exposed to ultraviolet (sun)light longer than allowed by manufacturer's written requirements.

PART 2 PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER

Provide a fluid-applied, vapor retarding, air barrier. This barrier must exhibit no visible water leakage when tested in accordance with ASTM E331 and must perform as a liquid water drainage plane with thru-wall flashing to discharge incidental condensation and water penetration to the exterior of the building enclosure. Provide products suitable for use within temperature ranges specified by manufacturer for the location of the project.

2.1.1 Physical Properties

- a. Air Permeance (ASTM E2178): in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM
- b. Air Leakage (ASTM E2357, ASTM E283): in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM and Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.
- c. Water Vapor Permeance (Vapor Impermeable Membrane) (ASTM E96/E96M, desiccant method A): 0.1 perms or less.
- d. Tensile Strength (ASTM D412): Not less than 138 psi.
- e. Elongation (ASTM D412): Not less than 300 percent.
- f. Low temperature Flexibility and Crack Bridging (ASTM C836/C836M): Pass at minus 15 degrees F.
- g. Solids by Volume: minimum 50 percent.
- h. Flame propagation of wall assemblies (NFPA 285): Pass
- i. Surface Burning Characteristics (ASTM E84):

(1) Flame Spread Index Rating not higher than 75.

(2) Smoke Developed Index Rating not higher than 150.

- j. Resistance to Mold, Mildew and Fungal Growth (ASTM D5590): 0, No growth.

2.2 PRIMERS, ADHESIVES, AND MASTICS

Provide primers, adhesives, mastics, sealants and other accessories as recommended by manufacturer of fluid-applied membrane air barrier for a complete installation.

2.3 TRANSITION MEMBRANE

Provide as specified in Section 07 27 19.01 SELF-ADHERING AIR BARRIERS.

2.4 SHEET METAL FLASHING

Provide as specified in Section 07 60 00 FLASHING AND SHEET METAL.

2.5 JOINT SEALANTS

Provide as specified in Section 07 92 00 JOINT SEALANTS.

2.6 REINFORCEMENT

Provide fiberglass mesh tape, or fluid-applied air barrier manufacturer's approved comparable equal product, reinforcement at seams, edges, projections and penetrations. Reinforce all joints exceeding 1/4 inch with fiberglass mesh.

PART 3 EXECUTION

3.1 EXAMINATION

Before installing fluid-applied membrane air barrier, examine substrates, areas, and conditions under which fluid-applied membrane air barrier assemblies will be applied, with installer present, for compliance with requirements. Ensure the following conditions are met:

- a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the membranes.
- b. Concrete and masonry surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions. Do not proceed with installation until after minimum concrete curing period recommended by fluid-applied membrane air barrier manufacturer.
- c. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints full flush.
- d. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263 and take suitable measures until substrate passes moisture test.

- e. Verify sealants used in substrates, and in joints between substrates, are compatible with fluid-applied membrane air barrier.

3.2 PREPARATION

Clean, prepare, and treat substrate in accordance with manufacturer's written instructions. Ensure clean, dust-free, and dry substrate for fluid-applied membrane air barrier application.

- a. Remove dust, dirt and other contaminants from joints and cracks before coating surfaces.
- b. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through fluid-applied membrane air barrier.
- c. At changes in substrate plane, provide transition material (bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under transition membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
- d. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Continuously support membrane with substrate.
- e. For exterior sheathing substrates, ensure that exterior sheathing is stabilized, with corners and edges fastened with appropriate screws. Treat all joints in accordance with the air barrier manufacturer's instructions prior to application of air barrier material. Allow sufficient time for joint treatments to fully cure before application of transition membranes and fluid-applied membrane air barrier.
- f. For concrete and masonry substrates, fill all voids and holes, particularly in mortar joints, with non-shrinking grout.
- g. Mask off and cover adjacent surfaces to protect from spillage and overspray.

3.3 INSTALLATION

3.3.1 Installation of Transition Membrane

Install transition membrane materials in accordance with the details on the drawings, Section 07 27 19.01 SELF-ADHERING AIR BARRIERS, and the following:

- a. Install transition membrane at all required locations prior to installation of the fluid-applied membrane air barrier.
- b. Verify transition membrane is fully adhered to substrate and that its surface is clean, dry and wrinkle free prior to installation of the fluid-applied membrane air barrier.
- c. Verify transition membrane completely covers all transition areas and will provide continuity of the finished fluid-applied membrane air barrier without gaps or cracks.

3.3.2 Installation of Flashing

Counterflash upper edge of thru-wall flashing and fluid-applied air barrier. Counter flashing and thru-wall flashing are specified in Section 07 60 00 FLASHING AND SHEET METAL.

3.3.3 Installation of Fluid-Applied Membrane Air Barrier

Install materials in accordance with manufacturer's recommendations and the following:

- a. Apply fluid-applied membrane air barrier in single or dual coat application by spray or roller. Apply fluid-applied membrane air barrier within manufacturer's recommended temperature range for application.
- b. Apply fluid-applied membrane air barrier in manner and at rate and wet film thickness recommended by manufacturer to yield a finished dry film thickness of not less than 60 mils or as otherwise required by the manufacturer for the application substrate material and surface roughness..
- c. Apply fluid-applied membrane air barrier around all penetrations ensuring a complete and continuous air barrier. Lap fluid-applied membrane air barrier a minimum of 3 inch over transition membrane to seal leading edge.
- d. Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, HVAC assemblies, plumbing and electrical assemblies, doors, windows, louvers, and other assemblies penetrating the fluid-applied membrane air barrier with a termination sealant recommended by the fluid-applied membrane air barrier manufacturer.
- e. Notify the Contracting Officer and Testing Agency upon completion of fluid-applied membrane air barrier installation. Air barrier materials and assemblies must remain exposed until tested and inspected by the ABAA.
- f. Do not allow materials to come in contact with chemically incompatible materials.

3.3.4 Installation of Reinforcement

Install reinforcement at projections, corners, joints, and penetrations where applicable.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Inspections and Testing

Provide site inspections and testing in accordance with ABAA protocol to verify conformance with the manufacturer's instructions, the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>), Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS, and this section.

- a. Conduct inspections and testing at 5, 50, and 95 percent completion of this scope of work. Forward written inspection reports to the

Contracting Officer within five working days of the inspection and test being performed.

- b. If the inspections reveal any defects, promptly remove and replace defective work at no additional expense to the Government.

3.5 PROTECTION AND CLEANING

3.5.1 Protection

Protect fluid-applied membrane air barrier assemblies from damage during application and remainder of construction in accordance with manufacturer's written instructions.

Coordinate installation, testing, and inspection procedures to ensure exposure period does not exceed that recommended by the product manufacturer. Remove and replace, at no additional cost to the government, membrane products that exceed manufacturer's allowed exposure limits.

3.5.2 Cleaning of Adjacent Surfaces

Clean excess product from adjacent construction using cleaning agents and procedures as recommended in writing by the manufacturer of each type of affected construction and as acceptable to same.

3.6 CLEANUP OF SPILLS

Conduct cleanup of uncured product spillage in accordance with manufacturer's written safe handling instructions.

-- End of Section --

SECTION 07 41 13

METAL ROOF PANELS
05/11, CHG 4: 02/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA ADM (2020) Aluminum Design Manual

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100 (2012) North American Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16 (2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

ASTM A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A653/A653M (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A1008/A1008M (2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

ASTM B117 (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM B209 (2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM C552 (2017; E 2018) Standard Specification for Cellular Glass Thermal Insulation

ASTM C553	(2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C792	(2015; R 2020) Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D522/D522M	(2017) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D610	(2008; R 2019) Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D714	(2002; R 2017) Standard Test Method for Evaluating Degree of Blistering of Paints
ASTM D822	(2013; R 2018) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	(2017) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1308	(2002; R 2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1654	(2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D1667	(2017) Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D1970/D1970M	(2019) Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D2244	(2016) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

ASTM D2247	(2015) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	(1993; R 2019) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3359	(2017) Standard Test Methods for Rating Adhesion by Tape Test
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D4587	(2011; R 2019; E 2019) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
ASTM D5894	(2016) Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E1592	(2017) Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E2140	(2001; R 2017) Standard Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head
ASTM G152	(2013) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2013) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

FM GLOBAL (FM)

FM 4471	(2010) Class I Panel Roofs
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METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA RSDM	(2012) Metal Roofing Systems Design Manual
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NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0420	(2010) Architectural Metal Flashing, Condensation Control and Reroofing
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NRCA RoofMan (2020) The NRCA Roofing Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA 1793 (2012) Architectural Sheet Metal Manual,
7th Edition

UNDERWRITERS LABORATORIES (UL)

UL 580 (2006; Reprint Mar 2019) UL Standard for
Safety Tests for Uplift Resistance of Roof
Assemblies

UL Bld Mat Dir (updated continuously online) Building
Materials Directory

1.2 DESCRIPTION OF METAL ROOF SYSTEM

1.2.1 Performance Requirements

Steel panels and accessory components must conform to the following standards:

ASTM A1008/A1008M

ASTM A123/A123M

ASTM A36/A36M

ASTM D522/D522M for applied coatings

UL Bld Mat Dir

1.2.1.1 Hydrostatic Head Resistance

No water penetration when tested according to ASTM E2140. Submit leakage test report upon completion of installation.

1.2.1.2 Wind Uplift Resistance

Provide metal roof panel system that conform to the requirements of ASTM E1592 and UL 580. Uplift force due to wind action governs the design for panels. Submit wind uplift test report prior to commencing installation.

Provide roof system and attachments that resist the wind loads as determined by ASCE 7-16, in pounds per square foot. Metal roof panels and component materials must also comply with the requirements in FM 4471 as part of a panel roofing system as listed in Factory Mutual Guide (FMG) "Approval Guide" for class 1 or noncombustible construction, as applicable. Identify all materials with FMG markings.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance

with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roofing Panels; G
Soffit Panels; G
Flashing and Accessories; G
Gutter/Downspout Assembly; G
Snow Retention System; G

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Roof Panels; G
Soffit Panels; G
Snow Retention System; G
Heat Island Reduction; S
Factory-Applied Color Finish; G
Accessories
Fasteners
Pressure Sensitive Tape
Underlayments; G
Gaskets and Sealing/Insulating Compounds
Coil Stock; G

SD-04 Samples

Roof Panels
Soffit Panels; G
Snow Retention System; G
Factory-applied Color Finish, Samples, 9 inch lengths, full width;
G
Accessories
Fasteners
Gaskets and Sealant/Insulating Compounds

SD-05 Design Data

Engineering Calculations; G

Wind Uplift Resistance; G

SD-06 Test Reports

Leakage Test Report; G

Wind Uplift Test Report; G

Factory Finish and Color Performance Requirements; G

SD-07 Certificates

Roof Panels; G

Coil Stock Compatibility

Self-Adhering Modified Bitumen Underlayment; G

Qualification of Manufacturer

Qualification of Applicator

EPD(s); S

Recycled Content; S

Regional Material; S

SD-08 Manufacturer's Instructions

Insulation

Installation Manual

SD-09 Manufacturer's Field Reports

Manufacturer's Field Inspection Reports; G

SD-11 Closeout Submittals

Warranties

Information Card

Date Of Installation Wall-Mounted Placard

1.3.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1.1 SS Heat Island Reduction

Product Test Reports for Credit SS Heat Island Reduction: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirement as specified.

1.3.1.2 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.1.3 M&R Sourcing of Raw Materials

Provide recycled content certifications of roof panel products.

Provide regional material certifications of applicable materials.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Submit documentation verifying metal roof panel manufacturer has been in the business of manufacturing metal roof panels for a period of not less than 5 years.

1.4.1.1 Manufacturer's Technical Representative

The manufacturer's technical representative must be thoroughly familiar with the products to be installed, installation requirements and practices, and with any special considerations in the geographical area of the project. The representative must perform field inspections and attend meetings as specified.

1.4.1.2 Single Source

Provide roofing panels, clips, closures, and other accessories that are standard products of the same manufacturer, and the most recent design of the manufacturer to operate as a complete system for the intended use.

1.4.2 Qualification of Applicator

Metal roof system applicator must be approved, authorized, or licensed in writing by the roof panel manufacturer and have a minimum of three years experience as an approved, authorized, or licensed applicator with that manufacturer, approved at a level capable of providing the specified warranty. Supply the names, locations and client contact information of 5 projects of similar size and scope constructed by applicator using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 Field Verification

Prior to the preparation of drawings and fabrication, verify location of roof framing, roof openings and penetrations, and any other special conditions. Indicate all special conditions and measurements on final shop drawings.

1.4.4 Pre-roofing Conference

After approval of submittals and before performing roofing system installation work, hold a pre-roofing conference to review the following:

- a. Drawings, specifications, and submittals related to the roof work.
Submit, as a minimum; sample profiles of roofing panels, with factory-applied color finish samples, flashing and accessories,

gutter/downspout assembly samples, typical fasteners and pressure sensitive tape, sample gaskets and sealant/insulating compounds. Also include technical data on coil stock and coil stock compatibility, and manufacturer's installation manual.

- b. Roof system components installation;
- c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing roof structure and substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative;
- d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and
- e. Quality control plan for the roof system installation;
- f. Safety requirements.

Coordinate pre-roofing conference scheduling with the Contracting Officer. Attendance is mandatory for the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of metal roof system, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, and representative of the metal roofing manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.4.5 Engineering Calculations

Provide engineering services by an authorized engineer, currently licensed in the geographic area of the project, with a minimum of five years experience as an engineer knowledgeable in roof wind design analysis, protocols and procedures for MBMA RSDM, ASCE 7-16, UL 580, and FM 4471. Engineer must provide certified engineering calculations for the project conforming to the stated references.

1.5 DELIVERY, HANDLING, AND STORAGE

Deliver, store, and handle panel materials, bulk roofing products, accessories, and other manufactured items in a manner to prevent damage and deformation, as recommended by the manufacturer, and as specified.

1.5.1 Delivery

Package and deliver materials to the site in undamaged condition. Provide adequate packaging to protect materials during shipment. Do not uncrate materials until ready for use, except for inspection. Immediately upon arrival of materials at jobsite, inspect materials for damage, deformation, dampness, and staining. Remove affected materials from the site and immediately replace. Remove moisture from wet materials not otherwise affected, restack and protect from further moisture exposure.

1.5.2 Handling

Handle materials in a manner to avoid damage. Select and operate material

handling equipment so as not to damage materials or applied roofing.

1.5.3 Storage

Stack materials stored on site on platforms or pallets, and cover with tarpaulins or other weathertight covering which prevents trapping of water or condensation under the covering. Store roof panels so that water which may have accumulated during transit or storage will drain off. Do not store panels in contact with materials that might cause staining. Secure coverings and stored items to protect from wind displacement.

1.6 PROJECT CONDITIONS

Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements, and specified safety requirements.

1.7 FABRICATION

Fabricate and finish metal roof panels and accessories on a factory stationary industrial type rolling mill to the greatest extent possible, per manufacturer's standard procedures and processes, and as necessary to fulfill indicated performance requirements. Comply with indicated profiles, dimensional and structural requirements.

Provide panel profile, as indicated on drawings including major ribs and intermediate stiffening ribs for full length of panel. Fabricate panel side laps with factory installed captive gaskets or separator strips providing a weather tight seal and preventing metal-to metal contact, and minimizing noise from movements within the panel assembly.

1.7.1 Finishes

Finish quality and application processes must conform to the related standards specified within this section. Noticeable variations within the same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize any contrasting variations.

1.7.2 Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 as applicable to the design, dimensions, metal, and other characteristics of the item indicated.

- a. Form exposed sheet metal accessories which are free from excessive oil canning, buckling, and tool marks, and are true to line and levels indicated, with exposed edges folded back to form hems.
- b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- c. Sealed Joints: Form non-expansion, but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA 1793.
- d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

- e. Fabricate cleats and attachments devices of size and metal thickness recommended by SMACNA or by metal roof panel manufacturer for application, but not less than the thickness of the metal being secured.

1.8 WARRANTIES

Provide metal roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to manufacturer's standard warranty as required to comply with the specified requirements.

1.8.1 Metal Roof Panel Manufacturer Warranty

Furnish the metal roof panel manufacturer's 30-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, components, trim, and accessories necessary for a watertight roof system construction. Make warranty directly to the Government, commencing at time of Government's acceptance of the roof work. The warranty must state that:

- a. If within the warranty period, the metal roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, displaces, corrodes, perforates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the metal roof system and correction of defective workmanship is the responsibility of the metal roof panel manufacturer. All costs associated with the repair or replacement work are the responsibility of the metal roof panel manufacturer.
- b. If the manufacturer or his approved applicator fail to perform the repairs within 24 hours of notification, emergency temporary repairs performed by others does not void the warranty.

1.8.2 Manufacturer's Finish Warranty

Provide a manufacturer's no-dollar-limit 30 year warranty for all prefinished alum covered in this specification. Issue the warranty directly to the Government at the date of Government acceptance, warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D2244.

1.8.3 Metal Roof System Installer Warranty

Provide roof system installer warranty for a period of not less than five years that the roof system, as installed, is free from defects in installation workmanship, to include the roof panel installation, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Issue warranty directly to the Government. Correction of defective workmanship and replacement of damaged or affected materials is the responsibility of the metal roof system installer. All costs associated with the repair or replacement work are the responsibility of the

installer.

1.8.4 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period must be approved, as required, and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the metal roof system manufacturer warranty for the remainder of the manufacturer warranty period.

1.9 CONFORMANCE AND COMPATIBILITY

Provide the entire metal roofing and flashing system in accordance with specified and indicated requirements, including wind resistance requirements. Perform work not specifically addressed and any deviation from specified requirements in general accordance with recommendations of the MBMA RSDM, NRCA RoofMan, the metal panel manufacturer's published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

PART 2 PRODUCTS

2.1 ROOF AND SOFFIT PANELS

2.1.1 Aluminum Sheet Panels

Roll-form aluminum roof panels to the specified profile, with f_y = as required to meet project requirements, no less than 0.040 inch thickness and depth as indicated.

Provide aluminum panels with a minimum recycled content of 30 percent. Provide data indicating percentage of recycled content for aluminum roof panels.

Material must be plumb and true, and within the tolerances listed:

- a. Aluminum sheet conforming to ASTM B209, and AA ADM
- b. Individual panels to have continuous length sufficient to cover the entire length of any unbroken roof slope with no joints or seams and formed without warping, waviness, or ripples that are not a part of the panel profile and free from damage to the finish coating system.
- c. Provide panels with thermal expansion and contraction consistent with the type of system specified, and the following profile:
 - (1) Roof Panels: Profile to be a 2 inch high standing seam, min 16 inch coverage with mechanical crimping seams with concealed clips, bearing plates and fasteners. Panel to have a flat surface with an embossed texture.
 - (2) Soffit Panels: Concealed fastener type, 12 inch wide x 1 inch deep. Panel to have a smooth texture and flat solid surface with flush reveals.

2.2 FACTORY FINISH AND COLOR PERFORMANCE REQUIREMENTS

All panels are to receive a factory applied Kynar 500/Hylar 5000 finish

consisting of a baked topcoat with a manufacturer's recommended prime coat conforming to the following:

- a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with an acid rinse, and thorough drying.
- b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. Oven cure the prime coat prior to application of the finish coat.
- c. Exterior Finish Coating: Apply the exterior finish coating over the primer by roll coating to a dry film thickness of 0.80 plus 0.05 mils (3.80 plus 0.05 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 plus 0.10 mils (4.00 plus 0.10 mils for Vinyl Plastisol). Oven cure this exterior finish coat.
- d. Interior finish coating: Apply a wash coat on the reverse side over primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. Oven cure the wash coat.
- e. Color: Provide finish color as indicated on drawings. Color to be selected from premium metallic cool colors. Color to have a emissivity of 0.85 and reflectivity of 0.50.
- f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

General:	ASTM D5894 and ASTM D4587
Abrasion:	ASTM D968
Adhesion:	ASTM D3359
Chalking:	ASTM D4214
Chemical Pollution:	ASTM D1308
Color Change and Conformity:	ASTM D2244
Creepage:	ASTM D1654
Cyclic Corrosion Test:	ASTM D5894
Flame Spread:	ASTM E84
Flexibility:	ASTM D522/D522M

Formability:	ASTM D522/D522M
Gloss at 60 and 85 degrees:	ASTM D523
Humidity:	ASTM D2247 and ASTM D714
Oxidation:	ASTM D610
Pencil Hardness:	ASTM D3363
Reverse Impact:	ASTM D2794
Salt Spray:	ASTM B117
Weatherometer:	ASTM G152, ASTM G153 and ASTM D822

2.2.1 Specular Gloss

Finished roof surfaces to have a specular gloss value of 10 or less at an angle of 85 degrees when measured in accordance with ASTM D523.

2.2.2 Energy Performance

Provide emittance and reflectance percentages, solar reflectance index values, to meet sustainable third party certification requirements for Heat Island Reduction.

2.3 MISCELLANEOUS METAL FRAMING

2.3.1 General

Provide cold formed metallic-coated steel sheet conforming to ASTM A653/A653M, AISI S100, and as specified in 05 40 00 COLD-FORMED METAL FRAMING unless otherwise indicated.

2.3.2 Fasteners and Miscellaneous Metal Framing

Provide compatible type, corrosion resistant, of sufficient size and length to penetrate the supporting element a minimum of one inch with other required properties to fasten miscellaneous metal framing members to substrates in accordance with the roof panel manufacturer's and ASCE 7-16 requirements.

2.3.2.1 Exposed Fasteners

Provide corrosion resistant stainless steel fasteners for roof panels, compatible with the sheet panel or flashing material and of the type and size recommended by the manufacturer to meet the performance requirements and design loads. Provide fasteners for accessories that are the manufacturer's standard. Provide an integral metal washer, matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick for exposed fasteners.

2.3.2.2 Screws

Provide corrosion resistant screws, stainless steel of the type and size

recommended by the manufacturer to meet the performance requirements.

2.3.2.3 Rivets

Provide closed-end type rivets, corrosion resistant stainless steel where watertight connections are required.

2.3.2.4 Attachment Clips

Provide stainless steel, series 300 clips. Size, shape, thickness and capacity must meet the thickness and design load criteria specified.

2.3.2.5 Bearing Plate

Provide 22 gage steel bearing plates under clips.

2.4 ACCESSORIES

Provide accessories compatible with the metal roof panels. Sheet metal flashing, trim, metal closure strips, caps, and similar metal accessories must be not less than the minimum thicknesses specified for roof panels. Provide exposed metal accessories to match the panels furnished. Provide molded foam rib, ridge and other closure strips that are closed-cell or solid-cell synthetic rubber or neoprene premolded to match configuration of the panels and not absorb or retain water.

2.4.1 Pre-manufactured Accessories

Provide pre-manufactured accessories that are manufacturer's standard for intended purpose, comply with applicable specification section, compatible with the metal roof system and approved for use by the metal roof panel manufacturer. Construct curbs to match roof slope.

2.4.1.1 Snow Retention System

Provide an aluminum snow retention system perpendicular to the slope of the roof consisting of a continuous guard bar, provided in longest practical lengths, mechanically attached with convex setscrews to standing seam ribs and snow clips between clips to further prevent falling snow and ice. Snow retention devices that glue to panel surfaces or use attachments that penetrate roof panels are prohibited. Roof warranties shall not be effected by snow retention system.

Design system to resist all in-service loads considering roof slope and design snow loads as indicated on drawings. Provide lab-tested holding strengths of devices and project specific engineering calculations. System to be prefinished with system and color provided on metal roof panels.

2.4.2 Metal Closure Strips

Provide factory fabricated aluminum closure strips of the same gauge, color, finish and profile as the specified roof panel.

2.4.3 Rubber Closure Strips

Provide closed-cell, expanded cellular rubber closure strips conforming to ASTM D1056 and ASTM D1667, extruded or molded to the configuration of the specified roof panel profile and in lengths supplied by roof panel

manufacturer.

2.5 JOINT SEALANTS

2.5.1 Sealants

Sealants are to be an approved gun type for use in hand or air pressure caulking guns at temperatures above 40 degrees F (or frost-free application at temperatures above 10 degrees F) with a minimum solid content of 85 percent of the total volume. Ensure sealant dries with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather tight joint. No migratory staining, in conformance with to ASTM C792, is permitted on painted or unpainted metal, stone, glass, vinyl or wood.

Prime all joints to receive sealants with a compatible one-component or two-component primer as recommended by the roof panel manufacturer.

2.5.1.1 Shop Applied Sealants

Provide sealant for shop-applied caulking that is an approved gun grade, non-sag one-component polysulfide or silicone conforming to ASTM C792 and ASTM C920, Type II, with a curing time which ensures the sealants plasticity at the time of field erection. Color to match panel color.

2.5.1.2 Field Applied Sealants

Provide sealants for field-applied caulking that is an approved gun grade, non-sag on-component polysulfide or two component polyurethane with an initial maximum Shore A durometer hardness of 25, conforming to ASTM C920, Type II. Color to match panel color.

2.5.1.3 Tape Sealants

Provide pressure sensitive, 100 percent solid tape sealant with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the roof panel manufacturer.

2.5.2 Sheet Metal Flashing and Trim

2.5.2.1 Fabrication, General

Custom fabricate sheet metal flashing and trim to comply with recommendations within the SMACNA 1793 that apply to design, dimensions, metal type, and other characteristics of design indicated. Shop fabricate items to the greatest extent possible. Obtain and verify field measurements for accurate fit prior to shop fabrication. Fabricate flashing and trim without excessive oil canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

2.5.2.2 Roof Drainage Sheet Metal Fabrications

Gutters: Fabricate to cross section indicated, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 96 inch long sections. Fabricate expansion joints and accessories from the same metal as gutters, unless otherwise indicated.

Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers of same material as downspouts and anchors.

2.6 INSULATION

Provide insulation, facer material and attachment compatible with metal roof system specified, as approved by the roof panel manufacturer, and conform to ASTM C552 (cellular glass) or ASTM C553 (fiber blankets).

2.7 UNDERLAYMENTS

2.7.1 Self-Adhering Modified Bitumen Underlayment

Provide self-adhering modified bitumen membrane underlayment material in compliance with ASTM D1970/D1970M, suitable for use as underlayment for metal roofing. Use membrane resistant to cyclical elevated temperatures for extended period of time in high heat service conditions. Provide membrane with integral non-tacking top surface of polyethylene film or other surface material to serve as separator between bituminous material and metal products to be applied above.

2.8 GASKETS AND SEALING/INSULATING COMPOUNDS

Provide gaskets and sealing/insulating compounds that are nonabsorptive and suitable for insulating contact points of incompatible materials. Utilize sealing/insulating compounds that are non-running after drying.

2.9 FINISH REPAIR MATERIAL

Only use repair and touch-up paint supplied by the roof panel manufacturer and is compatible with the specified system.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the work. Ensure surfaces are suitable, dry and free of defects and projections which might affect the installation.

Examine primary and secondary roof framing to verify that rafters, purlins, angels, channels, and other structural support members for panels and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer, UL, ASTM, and ASCE 7-16 requirements.

Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking; and that installation is within flatness tolerances required by metal roof panel manufacturer.

Examine rough-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of panels prior to installation.

Submit a written report to the Contracting Officer, endorsed by the installer, listing conditions detrimental to the performance of the work. Proceed with installation only after defects have been corrected.

Do not install items that show visual evidence of biological growth.

3.2 INSTALLATION

Perform installation meeting specified requirements and in accordance with the manufacturer's installation instructions and approved shop drawings. Do not install damaged materials. Insulate dissimilar materials which are not compatible when contacting each other by means of gaskets or sealing/insulating compounds. Keep all exposed surfaces and edges clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Remove stained, discolored, or damaged materials from the site.

3.2.1 Preparation

Clean all substrate substances which may be harmful to insulation, and roof panels including removing projections capable of interfering with insulation, and roof panel attachment.

Install sub-purlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written instructions.

3.2.2 Underlayment

Install underlayment according to roof panel manufacturer's written recommendations and recommendation in NRCA "The NRCA Roofing and Waterproofing Manual".

3.2.2.1 Self-Adhering Sheet Underlayment

Install self-adhering sheet underlayment; wrinkle free on roof deck. Comply with low-temperature installation restrictions of manufacturer where applicable. Lap in a direction to shed water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.

Install underlayment continuously. Underlayment to extend a min 8 inch vertically up sidewalls and over roof curbs.

3.3 INSULATION INSTALLATION

Install insulation concurrently with metal roof panel installation, in thickness indicated, to cover entire roof, according to manufacturer's written instructions.

3.4 PROTECTION OF APPLIED MATERIALS

Do not permit storing, walking, wheeling, and trucking directly on applied roofing/insulation materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing/insulation materials, and to distribute weight to conform to indicated live load limits of roof construction.

3.5 FASTENER INSTALLATION

Anchor metal roof panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written

instructions.

3.6 FLASHING, TRIM, AND CLOSURE INSTALLATION

3.6.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently water tight and weather resistant. Work is to be accomplished to form weather tight construction without waves, warps, buckles, fastening stresses or distortion, and to allow for expansion and contraction. Perform cutting, fitting, drilling, and other operations in connection with sheet metal required to accomplish the work in conformance with the manufacturers written instructions.

3.6.2 Metal Flashing

Install exposed metal flashing at building corners, rakes, eaves, junctions between metal siding and roofing, valleys and changes off slope or direction in metal roofing, building expansion joints and gutters.

Utilize exposed metal flashing that is the same material, color, and finish as the specified metal roofing panels. Furnish flashing in minimum 8 foot lengths. Exposed flashing must have 1 inch locked and blind soldered end joints, with expansion joints at intervals of no greater than 16 feet.

Fasten flashing at not more than 8 inches on center for roofs, except where flashing is held in place by the same screws used to secure panels. Bed exposed flashing and flashing subject to rain penetration in specified joint sealant. Isolate flashing which is in contact with dissimilar metals by means of the specified asphalt mastic material to prevent electrolytic deterioration.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.7 ROOF PANEL INSTALLATION

Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels or other components of the Work securely in place, with provisions for thermal and structural movement in accordance with NRCA 0420.

Aluminum Roof Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior and aluminum or galvanized steel fasteners for unexposed surfaces.

Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written instructions. Provide all blocking and nailers as required.

Metal Protection: Where dissimilar metals contact each other or possibly corrosive substrates, protect against galvanic action by permanent separation as recommended by the metal roof panel

manufacturer.

Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and required for weatherproof performance of metal roof panel system. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

3.7.1 Handling and Erection

Erect roofing system in accordance with the approved erection drawings, printed instructions and safety precautions of the manufacturer.

Do not subject panels to overloading, abuse, or undue impact. Do not apply bent, chipped, or defective panels. Replace and remove from the site any damaged panels at the Contractor's expense. Erect panels true, plumb, and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with indicated rake, eave, and curb overhang. Allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure.

Do not permit storage, walking, wheeling or trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of the roof construction.

Lay roof panels with corrugations in the direction of the roof slope. Lap ends of exterior roofing not less than 8 inches; lap sides of standard exterior corrugated panels not less than 2-1/2 corrugations.

Field cutting of metal roof panels by torch is not permitted. Field cut only as recommended by manufacturer's written instructions.

3.7.2 Closure Strips

Install metal closure strips at open ends of metal ridge rolls; open ends of corrugated or ribbed pattern roofs, and at intersection of wall and roof, unless open ends are concealed with formed eave flashing; rake of metal roof unless open end has a formed flashing member; and in other required areas.

Install closure strips at intersection of the wall with metal roofing; top and bottom of metal siding; heads of wall openings; and in other required locations.

3.7.3 Workmanship

Make lines, arises, and angles sharp and true. Free exposed surfaces from any visible wave, warp, buckle and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793.

Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and as necessary to make the work watertight.

3.8 ACCEPTANCE PROVISIONS

3.8.1 Erection Tolerances

Erect metal roofing straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions. Horizontal lines must not vary more than 1/4 inch in 20 feet or 3/8 inch in 40 feet.

3.8.2 Leakage Tests

Finished application of metal roofing is to be subject to inspection and test for leakage by the Contracting Officer or his designated representative, and Architect/Engineer. Inspection and tests will be conducted without cost to the Government.

Inspection and testing is to be made promptly after erection to permit correction of defects and removal/replacement of defective materials.

3.8.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials and as recommended by the metal roof panel manufacturer. Finished repaired surfaces must be uniform and free from variations of color and surface texture. Repaired metal surfaces that are not acceptable to the project requirements are to be immediately removed and replaced with new material.

3.8.4 Paint Finished Metal Roofing

Paint finished metal roofing will be tested for color stability by the Contracting Officer during the manufacturer's specified guarantee period. Remove and replace panels that indicate color changes, fading, or surface degradation, determined by visual examination with new panels at no expense to the Government. New panels will be subject to the specified tests for an additional year from the date of their installation.

3.9 CLEAN UP AND DISPOSAL

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating. Touch up scratches in panel finish with manufacturer supplied touch-up paint system to match panel finish. Treat exposed cut edges with manufacturer supplied clear coat.

Collect all scrap/waste materials and place in containers. Promptly dispose of demolished and scrap materials. Do not allow scrap/waste materials to accumulate on-site; transport immediately from the government property and legally dispose of them.

3.10 FIELD QUALITY CONTROL

3.10.1 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of three times during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Make inspections during the first 20 squares of roof panel installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections are required for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer. After each inspection, submit a report, signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

Submit three signed copies of the manufacturer's field inspection reports to the Contracting Officer within one week of substantial completion.

3.11 INFORMATION CARD

For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Format as directed in paragraph FORM ONE.

Make card 8 1/2 by 11 inches minimum, identifying facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, roof panel manufacturer and product name, type underlayment(s), date of completion; installing contractor identification and contact information; manufacturer warranty expiration, warranty reference number, and contact information. Install card at location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

3.11.1 Form One

FORM 1 - PREFORMED ALUMINUM PANEL ROOFING SYSTEM AND COMPONENTS

1. Contract Number:
2. Building Number & Location:
3. NAVFAC Specification Number:
4. Deck/Substrate Type:
5. Slopes of Deck/Roof Structure:
6. Insulation Type & Thickness:
7. Insulation Manufacturer:
8. Vapor Retarder: ()Yes ()No
9. Vapor Retarder Type:
10. Preformed Standing Seam Roofing Description:
 - a. Manufacturer (Name, Address, & Phone No.):
 - b. Product Name:
 - c. Width:
 - d. Gage:
 - e. Base Metal:
 - f. Method of Attachment:
11. Repair of Color Coating:
 - a. Coating Manufacturer (Name, Address & Phone No.):
 - b. Product Name:
 - c. Surface Preparation:
 - d. Recoating Formula:
 - e. Application Method:
12. Statement of Compliance or Exception: _____

13. Date Roof Completed:
14. Warranty Period: From _____ To _____
15. Roofing Contractor (Name & Address):
16. Prime Contractor (Name & Address):

Contractor's Signature _____ Date:

Inspector's Signature _____ Date:Text

3.12 DATE OF INSTALLATION WALL-MOUNTED PLACARD

For each metal roof panel installation, furnish an exterior "Date of Installation Placard", 0.032 inch thick aluminum, 8-1/2 inches high by 11 inches wide, with mounting accessories, photoengraved to include the following information:

Facility Name and Number
Approximate Roof Area Newly Installed and Date of Completion
Manufacturer, Type of Roof Panel and Name
Underlayment and Insulation System, R value
Installing Contractor and Contact Information
Warranty Expiration Date
Warranty Reference Number and Contact Information

Install placard as directed by the Contracting Officer.

3.13 WARRANTY

CONTRACTOR'S THIRTY (30) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM

FACILITY DESCRIPTION_____

BUILDING NUMBER:_____

CORPS OF ENGINEERS CONTRACT NUMBER:_____

CONTRACTOR

CONTRACTOR:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

OWNER

OWNER:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONSTRUCTION AGENT

CONSTRUCTION AGENT:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONTRACTOR'S THIRTY (30) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM
(continued)

THE NON-STRUCTURAL METAL ROOF SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY _____ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE. THE NON-STRUCTURAL METAL ROOFING SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: THE ENTIRE ROOFING SYSTEM, MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH UL 580. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHING INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE NON-STRUCTURAL METAL ROOFING SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE NON-STRUCTURAL METAL ROOF SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON _____ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

(Company President)

(Date)

CONTRACTOR'S THIRTY (30) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOFING SYSTEM
(continued)

THE CONTRACTOR MUST SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE NON-STRUCTURAL METAL ROOFING SYSTEM. SUBMIT ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR IS ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).
2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.
3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.
4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.
5. FAILURE OF ANY PART OF THE NON-STRUCTURAL METAL ROOF DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE OF WATER FROM THE ROOF AND GUTTERS AND DOWNSPOUTS OR ALLOW PONDING WATER TO COLLECT ON THE ROOF SURFACE. CONTRACTOR'S DESIGN MUST INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.
6. THIS WARRANTY APPLIES TO THE NON-STRUCTURAL METAL ROOFING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.
7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

CONTRACTOR'S THIRTY (30) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM
(continued)

**REPORTS OF LEAKS AND ROOF SYSTEM DEFICIENCIES MUST BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE, BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER OR CONTRACTING OFFICER. INITIATE EMERGENCY REPAIRS TO PREVENT FURTHER ROOF LEAKS IMMEDIATELY; SUBMIT A WRITTEN PLAN FOR APPROVAL TO REPAIR OR REPLACE THIS ROOF SYSTEM WITHIN SEVEN (7) CALENDAR DAYS. COMMENCE ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE NON-STRUCTURAL METAL ROOF SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

POST A FRAMED COPY OF THIS WARRANTY IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

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SECTION 07 42 13

METAL WALL PANELS
05/11, CHG 2: 02/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA ADM	(2020) Aluminum Design Manual
AA ASD1	(2017; Errata 2017) Aluminum Standards and Data

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.1	(2017) Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure
AAMA 800	(2016) Voluntary Specifications and Test Methods for Sealants

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100	(2012) North American Specification for the Design of Cold-Formed Steel Structural Members
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AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures
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ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A463/A463M	(2015; R 2020; E 2020) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A606/A606M	(2018) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance

ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A1008/A1008M	(2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D522/D522M	(2017) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D610	(2008; R 2019) Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D714	(2002; R 2017) Standard Test Method for Evaluating Degree of Blistering of Paints
ASTM D822	(2013; R 2018) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	(2017) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1308	(2002; R 2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1654	(2008; R 2016; E 2017) Standard Test

Method for Evaluation of Painted or Coated
Specimens Subjected to Corrosive
Environments

ASTM D1667	(2017) Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2244	(2016) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	(2015) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	(1993; R 2019) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3359	(2017) Standard Test Methods for Rating Adhesion by Tape Test
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D4587	(2011; R 2019; E 2019) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
ASTM D5894	(2016) Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM E72	(2015) Conducting Strength Tests of Panels for Building Construction
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E283	(2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2016) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E1592	(2017) Standard Test Method for Structural Performance of Sheet Metal Roof and Siding

Systems by Uniform Static Air Pressure
Difference

ASTM G152 (2013) Operating Open Flame Carbon Arc
Light Apparatus for Exposure of
Nonmetallic Materials

ASTM G153 (2013) Operating Enclosed Carbon Arc Light
Apparatus for Exposure of Nonmetallic
Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM (2018) Metal Building Systems Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 (2006) Metal Finishes Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA 1793 (2012) Architectural Sheet Metal Manual,
7th Edition

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (updated continuously online) Building
Materials Directory

1.2 DEFINITIONS

Metal Wall Panel: Metal wall panels, attachment system components and accessories necessary for a complete weather-tight wall system.

1.3 DESCRIPTION OF WALL PANEL SYSTEM

Factory color finished, aluminum metal wall panel system with concealed fastening attachment. Panel profile must be smooth face as shown on drawings.

1.3.1 Metal Wall Panel General Performance

Comply with performance requirements, conforming to AISI S100, without failure due to defective manufacture, fabrication, installation, or other defects in construction. Wall panels and accessory components must conform to the following standards:

ASTM A1008/A1008M
ASTM A123/A123M
ASTM A36/A36M
ASTM A653/A653M
ASTM A463/A463M for aluminum coated steel sheet
ASTM A606/A606M
ASTM A780/A780M for repair of damage or uncoated areas of hot-dipped galvanized coating.
ASTM A924/A924M for metallic coated steel sheet
ASTM D522/D522M for applied coatings
UL Bld Mat Dir

1.3.2 Structural Performance

Maximum calculated fiber stress must not exceed the allowable value in the AISI or AA manuals; a one third overstress for wind is allowed. Midspan deflection under maximum design loads is limited to $L/180$. Contract drawings show the design wind loads and the extent and general assembly details of the metal siding. Contractor must provide design for members and connections not shown on the drawings. Siding panels and accessories must be the products of the same manufacturer.

Provide metal wall panel assemblies complying with the load and stress requirements in accordance with ASTM E1592. Wind Load force due to wind action governs the design for panels.

Wall systems and attachments are to resist the wind loads as determined by ASTM E72 and ASCE 7-16 in the geographic area where the construction will take place, in pounds per square foot. Submit five copies of wind load tests to the Contracting Officer.

1.3.3 Air Infiltration

Air leakage must conform to the limits through the wall assembly area when tested according to ASTM E283.

1.3.4 Water Penetration Under Static Pressure

No water penetration when tested according to ASTM E331.

1.3.5 Water Penetration Under Dynamic Pressure

No evidence of water leakage when tested according to AAMA 501.1.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Documentation for the following items:

Qualification of Manufacturer

Qualification of Installation Contractor

Sample Warranties

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Submit Manufacturer's data indicating percentage of recycle material in wall panels to verify sustainable acquisition compliance.

Submit Manufacturer's catalog data for the following items:

Wall Panels; G

Factory-Applied Color Finish; G

Closure Materials

Pressure Sensitive Tape

Sealants and Caulking

Galvanizing Repair Paint

Accessories

SD-04 Samples

Submit as required each of the following samples:

Wall Panels, 12 inches long by actual panel width; G

Metal Closure Strips, 10 inches long of each type; G

SD-05 Design Data

Wind load design analysis; G

As applicable, submit the following wind load design analysis data, to include, but not limited to:

wind speed

exposure category,co-efficient,importance factor

type of facility

negative pressures for each zone

methods and requirements of attachment

SD-06 Test Reports

Submit test reports for the following in accordance with the referenced articles in this section.

Leakage Tests; G

Wind Load Tests; G

Coating Tests

Chalking Tests

SD-07 Certificates

Submit certificates for the following items showing conformance with referenced standards contained in this section:

Coil Stock

Fasteners

EPD(s); S

Recycled Content; S

Regional Material; S

SD-08 Manufacturer's Instructions

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications.

Installation of Wall panels

SD-09 Manufacturer's Field Reports

Manufacturer's Field Reports; G

SD-11 Closeout Submittals

Warranties

Maintenance Instructions

1.4.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.4.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.4.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of wall panel products.

Provide regional material certifications of applicable materials.

1.5 QUALITY ASSURANCE

1.5.1 Pre-Installation Conference

Upon notification of submittal receipt and approval by the Contracting Officer; and prior to the commencement of the work, the Contractor must attend a pre-installation conference to review the following:

- a. Drawings and Specifications.
- b. Qualification of Installer.
- c. Sustainable acquisition
- d. Approved Warranty
- e. Sample wall panels, 12 inches long by actual panel width
- f. Sample metal closure strips, 10 inches long of each type

- g. Color charts and chips
- h. Coatings and base metal tests, chalking tests
- i. Construction schedule, availability of materials, Installer's personnel, equipment and facilities required to progress with the work without delay.
- j. Methods and procedures related to installation of wall panels, including manufacturer's written instructions. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.
- k. Support conditions for compliance with requirements, including alignment between and attachment to structural members.
- l. Flashing, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
- m. Governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
- n. Temporary protection requirements for metal wall panel assembly during and after installation.
- o. Wall panel observation and repair procedures after metal wall panel installation. Provide detailed written instructions including copies of Safety Data Sheets for maintenance and repair materials, and manufacturer's maintenance instructions.

1.5.1.1 Installation Drawings

Installation shop drawings for wall panels, flashing, accessories, and anchorage systems must indicate completely dimensioned structural frame and erection layouts, openings in the wall, special framing details, and construction details at corners, building intersections and flashing, location and type of mastic and metal filler strips.

1.5.1.2 Wind Load Design Analysis

Wind design analysis must include wall plan delineating dimensions and attachment patterns for each zone. Wind design analysis must be prepared and sealed by Licensed Project Engineer in the geographic area where the construction will take place.

1.5.2 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and installations in the geographical area where construction will take place.

1.5.3 Qualification of Manufacturer

Certify that metal wall panel system manufacturer has a minimum of five (5) years experience in manufacturing metal wall system and accessory products.

Manufacturer must also provide engineering services by an authorized engineer; currently licensed in the geographical area where construction

will take place, having a minimum of four (4) years experience as an engineer knowledgeable in wind load design analysis, protocols and procedures per MBMA MBSM, "Metal Building Systems Manual"; ASCE 7-16, and ASTM E1592.

Provide certified engineering calculations, using the products submitted, for Wind load requirements in accordance with ASCE 7-16.

1.5.3.1 Manufacturer's Certificates

Also provide the following certifications from the manufacturer:

Coil Stock
Fasteners
Galvanizing Repair Paint

Submit certification from coil stock manufacturer or supplier that the machinery used will form the provided coil stock without warping, waviness, or rippling that is not a part of the panel profile, and without damage, abrasion or marring of the finish coating.

Provide evidence that products used within this specification are manufactured in the United States.

1.5.4 Certified Qualification of Installation Contractor

The installation contractor must be approved and certified by the metal wall panel manufacturer prior to beginning the installation of the metal wall panel system. Subcontracting by Certified Contractor for the metal wall panel work is not permitted.

1.5.5 Single Source

Obtain each type of metal wall panels, clips, closure materials and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.5.6 Manufacturer's Maintenance Instructions

Provide manufacturer's detailed written instructions including copies of Safety Data Sheets for maintenance and repair materials.

1.6 DELIVERY, HANDLING, AND STORAGE

Deliver and protect package components, sheets, metal wall panels, and other manufactured items to prevent damage or deformation during transportation and handling.

Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

Stack and store metal wall panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

Retain strippable protective covering on metal wall panel until actual installation.

1.7 PROJECT CONDITIONS

1.7.1 Field Measurements

Verify locations of wall framing and opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.

1.7.2 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into wall system or building.

1.8 WARRANTIES

Warranty must conform to the Sample Warranty as reviewed and approved by the Contracting Officer.

1.8.1 20 Year "No Dollar Limit" Warranty for Labor and Material

Furnish manufacturer's no-dollar-limit warranty for the metal wall panel system. The warranty period is to be no less than twenty (20) years from the date of Government acceptance of the work. The warranty is to be issued directly to the Government. The warranty is to provide that if within the warranty period the metal wall panel system shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the wall panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal wall panel system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal wall panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

1.8.2 Manufacturer's Finish Warranty

Provide a manufacturer's no-dollar-limit 20 year warranty for the wall panel system. Issue the warranty directly to the Government at the date of Government acceptance, warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D2244.

PART 2 PRODUCTS

2.1 FABRICATION

Unless approved otherwise, fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated and specified performance requirements. Comply with indicated profiles and with dimensional and structural requirements. See section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING for cumulative total recycled content requirements.

Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Fabricate metal wall panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

2.1.1 Sheet Metal Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

- a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- b. End Seams: fabricate nonmoving end seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- c. Sealed Joints: form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA 1793.
- d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
- e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA 1793 or by metal wall panel manufacturer for application, but not less than thickness of metal being secured.

2.2 PANEL MATERIALS

2.2.1 Aluminum Sheet

Roll-form aluminum wall panels to the specified profile, with .050 inches thickness and depth as indicated. Material must be plumb and true, and within the tolerances listed:

- a. Aluminum Sheet conforming to ASTM B209, AA ASD1 and AA ADM.
- b. Individual panels must be have continuous length to cover the entire length of any wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.
- c. Provide panels with thermal expansion and contraction consistent with the type of system specified.
 1. Profile and coverage to be a minimum height and width from manufacturer's standard for the indicated wall area.
 2. Panels to have a coverage of 12 inches. Panel thickness to be min 1 inch. Panels to have a flush interchangeable common lock-joint permitting the placement of concealed fasteners and minimizing moisture intrusion. All panels to utilize concealed clips and fasteners. Manufacturer to provide lengths of panels as indicated on drawings. Provide field applied notched nailing flanges to accommodate panel expansion and contraction. Install

panels using shims as needed to minimize the effect of oil canning.

a. Typical panel profile to have a raised flat pan.

b. Panels at blue accent areas to have a raised flat pan with a single centered stiffener bead/pencil rib.

3. Panels to have a smooth texture.

2.2.2 Factory-Applied Color Finish

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes. Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

All panels are to receive a factory-applied Kynar 500/Hylar 5000 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

2.2.2.1 Metal Preparation

Carefully prepare all metal surface for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.

2.2.2.2 Prime Coating

Apply a base coat of epoxy paint, specifically formulated to interact with the top-coat, to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. Prime coat must be oven cured prior to application of finish coat.

2.2.2.3 Exterior Finish Coating

Roll coat the finish coating over the primer by roll coating to dry film thickness of 0.80 plus 5 mils (3.80 plus 0.50 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 plus 0.10 mils (4.00 plus 0.10 mils for Vinyl Plastisol). Oven-cure finish coat.

2.2.2.4 Interior Finish Coating

Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. Oven-cured the wash coat.

2.2.2.5 Color

Provide custom exterior finish color as indicated on drawings.

2.2.2.6 Physical Properties

Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

General:	ASTM D5894 and ASTM D4587
Abrasion:	ASTM D968
Adhesion:	ASTM D3359
Chalking:	ASTM D4214
Chemical Pollution:	ASTM D1308
Color Change and Conformity:	ASTM D2244
Creepage:	ASTM D1654
Cyclic Corrosion Test:	ASTM D5894
Flame Spread:	ASTM E84
Flexibility:	ASTM D522/D522M
Formability:	ASTM D522/D522M
Gloss at 60 and 85 degrees:	ASTM D523
Humidity:	ASTM D2247 and ASTM D714
Oxidation:	ASTM D610
Pencil Hardness:	ASTM D3363
Reverse Impact:	ASTM D2794
Salt Spray:	ASTM B117
Weatherometer:	ASTM G152, ASTM G153 and ASTM D822

2.3 MISCELLANEOUS METAL FRAMING

Cold-formed metallic-coated steel sheet conforming to ASTM A653/A653M and specified in Section 05 40 00 COLD-FORMED METAL FRAMING unless otherwise indicated.

2.3.1 Fasteners for Miscellaneous Metal Framing

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties required to fasten miscellaneous metal framing members to supporting members and substrates in accordance with the wall panel manufacturer's and ASCE 7-16 requirements.

2.4 FASTENERS

2.4.1 General

2.4.1.1 Exposed Fasteners

Use of exposed fasteners not allowed.

2.4.1.2 Hidden Fasteners

Provide corrosion resistant fasteners recommended by the manufacturer to meet the performance requirements and design loads.

2.4.1.3 Screws

Screws to be corrosion resistant coated steel, aluminum and/or 300 - series stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.4.1.4 Rivets

Rivets to be closed-end type, corrosion resistant coated steel, aluminum or stainless steel where watertight connections are required.

2.4.1.5 Attachment Clips

Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A653/A653M, Z275 G 90 or Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load criteria specified.

2.5 ACCESSORIES

2.5.1 General

All accessories must be compatible with the metal wall panels. Sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the wall panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other closure strips must be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

2.5.2 Rubber Closure Strips

Provide closed-cell, expanded cellular rubber conforming to ASTM D1056 and ASTM D1667; extruded or molded to the configuration of the specified wall panel and in lengths supplied by the wall panel manufacturer.

2.5.3 Metal Closure Strips

Provide factory fabricated aluminum closure strips to be the same thickness, color, finish and profile of the specified wall panel.

2.5.4 Joint Sealants

2.5.4.1 Sealants and Caulking

Provide approved gun type sealants for use in hand- or air-pressure

caulking guns at temperatures above 40 degrees F (or frost-free application at temperatures above 10 degrees F with minimum solid content of 85 percent of the total volume. Sealants must dry with a tough, durable surface skin which permit remaining soft and pliable underneath, providing a weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Prime all joints receiving sealants with a compatible one-component or two-component primer as recommended by the wall panel manufacturer.

2.5.4.2 Shop-Applied

Sealant for shop-applied caulking must be non-curing butyl compliant with AAMA 800 to ensure the sealant's plasticity at the time of field erection.

2.5.4.3 Field-Applied

Sealant for field-applied caulking must be an approved gun grade, non-sag one component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and conforming to ASTM C920, Type II. Color to match panel colors.

2.5.4.4 Pressure Sensitive Tape

Provide pressure sensitive tape sealant, 100 percent solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the wall panel manufacturer.

2.6 SHEET METAL FLASHING AND TRIM

2.6.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.7 REPAIR OF FINISH PROTECTION

Repair paint for color finish wall panel must be compatible paint of the same formula and color as the specified finish furnished by the wall panel manufacturer. Provide 4 quarts of repair paint matching the specified wall panels.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of the Work.

Examine primary and secondary wall framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by

metal wall panel manufacturer, UL, ASTM, ASCE 7-16 and as required for the geographical area where construction will take place.

Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

Submit to the Contracting Officer a written report, endorsed by Installer, listing conditions detrimental to performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment. Miscellaneous framing installation, including sub-purlins, girts, angles, furring, and other miscellaneous wall panel support members and anchorage must be according to metal wall panel manufacturer's written instructions.

3.3 WALL PANEL INSTALLATION

Provide full length metal wall panels, from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement in accordance with MBMA MBSM.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Bent, chipped, or defective sheets shall not be applied.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting metal wall panels by torch is not permitted.

3.3.1 Aluminum Wall Panels

Use aluminum or stainless-steel fasteners for exterior surfaces and aluminum or galvanized steel fasteners for interior surfaces.

3.3.2 Anchor Clips

Anchor metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.3.3 Metal Protection

Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.

3.3.4 Joint Sealers

Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

3.4 FASTENER INSTALLATION

Anchor metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.5 FLASHING, TRIM AND CLOSURE INSTALLATION

3.5.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams to form permanently watertight and weather resistant.

Install sheet metal work is to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

3.5.2 Metal Flashing

Install exposed metal flashing at building corners, sills and eaves, junctions between metal siding and walling. Exposed metal flashing must be the same material, color, and finish as the specified metal wall panel.

Fasten flashing at a minimum of 8 inches on center, except where flashing is held in place by the same screws that secure covering sheets.

Flashing is to be furnished in at least 8 foot lengths. Exposed flashing is to have 1 inch locked and blind-soldered end joints, and expansion joints at intervals of not more than 16 feet.

Exposed flashing and flashing subject to rain penetration to be bedded in the specified joint sealant.

Isolate flashing which is in contact with dissimilar metals by means of the specified asphalt mastic material to prevent electrolytic deterioration.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.5.3 Closures

Install metal closure strips at open ends of corrugated or ribbed pattern walls, and at intersection of wall and wall unless open ends are concealed with formed eave flashing; and in other required areas.

Install mastic closure strips at intersection of the wall with metal walling; top and bottom of metal siding; heads of wall openings; and in other required locations.

3.6 WORKMANSHIP

Make lines, arises, and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight.

3.7 ACCEPTANCE PROVISIONS

3.7.1 Erection Tolerances

Erect metal wall panels straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions.

3.7.2 Leakage Tests

Finished application of metal wall panels are to be subject to inspection and test for leakage by request of the Contracting Officer, Architect/Engineer. Conduct inspection and tests at no cost to the Government.

Inspection and testing is to be made promptly after erection to permit correction of defects and the removal and replacement of defective materials.

3.7.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials. Finished repaired surfaces must be uniform and free from variations of color and surface texture.

Repaired metal surfaces that are not acceptable to the project requirements and/or Contracting Officer are to be immediately removed and replaced with new material.

3.7.4 Paint-Finish Metal Siding

Paint-finish metal siding will be tested for color stability by the

Contracting Officer during the manufacturer's specified guarantee period.

Panels that indicate color changes, fading, or surface degradation, determined by visual examination, must be removed and replaced with new panels at no expense to the Government.

New panels will be subject to the specified tests for an additional year from the date of their installation.

3.8 FIELD QUALITY CONTROL

3.8.1 Construction Monitoring

Make visual inspections as necessary to ensure compliance with specified requirements. Additionally, verify the following:

- a. Materials comply with the specified requirements.
- b. All materials are properly stored, handled and protected from damage. Damaged materials are removed from the site.
- c. Framing and substrates are in acceptable condition, in compliance with specification, prior to application of wall panels.
- d. Panels are installed without buckles, ripples, or waves and in uniform alignment and modulus.
- e. Side laps are formed, sealed, fastened or seam locked as required.
- f. The proper number, type, and spacing of attachment clips and fasteners are installed.
- g. Installer adheres to specified and detailed application parameters.
- h. Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

Provide Manufacturer's Field Reports to the Contracting Officer two weeks prior to project close-out.

3.9 CLEAN-UP AND DISPOSAL

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder marks, and damage to the finish coating.

Collect and place scrap/waste materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site; transport demolished materials from government property and legally dispose of them.

-- End of Section --

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SECTION 07 52 00

MODIFIED BITUMINOUS MEMBRANE ROOFING

05/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16 (2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.24 (2014) Roofing - Safety Requirements of Low-Sloped Roofs

ASPHALT ROOFING MANUFACTURER'S ASSOCIATION (ARMA)

ARMA 410BUR88 (2001) Manual of Roof Maintenance and Repair

ARMA PMBRG98 (1998) Quality Control Guideline for the Application of Polymer Modified Bitumen Roofing

ASTM INTERNATIONAL (ASTM)

ASTM C1153 (2010) Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging

ASTM C1289 (2020) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

ASTM D41/D41M (2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

ASTM D1970/D1970M (2019) Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

ASTM D4073/D4073M (2006; E 2019; R 2019) Standard Test Method for Tensile-Tear Strength of Bituminous Roofing Membranes

ASTM D4586/D4586M (2007; E 2012; R 2012) Asphalt Roof Cement, Asbestos-Free

ASTM D4637/D4637M (2015) EPDM Sheet Used in Single-Ply Roof Membrane

ASTM D5147/D5147M (2014) Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material

ASTM D6162/D6162M (2016) Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements

ASTM D6164/D6164M (2016) Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements

FM GLOBAL (FM)

FM 4470 (2016) Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction

FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA C3701 (1997) Repair Manual for Low Slope Membrane Roof Systems

NRCA CONDET (2014) Construction Details Manual

NRCA RoofMan (2020) The NRCA Roofing Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793 (2012) Architectural Sheet Metal Manual, 7th Edition

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI/FM 4435/ES-1 (2017) Test Standard for Edge Systems Used with Low Slope Roofing Systems

1.2 DESCRIPTION OF ROOF MEMBRANE SYSTEM

Minimum two-ply SBS modified bitumen roof membrane consisting of modified bitumen base sheet and cap sheet. Modified bitumen roof membrane base and cap sheets must be set in cold-applied adhesive.

All work must follow the NRCA RoofMan guidelines and standards stated within this Section.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roof Plan; G drawing depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, as applicable

Field Inspection and Existing Conditions Report

Identify all fire safety issues including exposed or concealed combustible materials, which may require additional protection during roof installation.

SD-03 Product Data

Modified Bitumen Sheets; G

Heat Island Reduction; S

Cold-Applied Membrane Adhesive; G

Primer; G

Modified Bitumen Roof Cement; G

Pre-Manufactured Accessories

Fasteners And Plates; G

Sample Warranty certificate; G

Submit all data required by Section 07 22 00 ROOF AND DECK INSULATION, together with requirements of this section. Include in data written acceptance by the roof membrane manufacturer of the products and accessories provided. Provide products as listed in the applicable wind uplift classification listings, unless approved otherwise by the Contracting Officer.

SD-05 Design Data

Wind Uplift Calculations; G

Provide Engineering calculations, signed, sealed, and dated by a qualified Engineer validating the wind resistance per ASCE 7-16, ASTM D4073/D4073M, and ANSI/SPRI/FM 4435/ES-1 of non-rated roof system.

SD-07 Certificates

Provide evidence that products used within this specification are manufactured in the United States.

Qualification of Manufacturer

Certify that the manufacturer of the modified bitumen membrane meets requirements specified under paragraph QUALIFICATION OF MANUFACTURER.

Qualification of Applicator

Certify that the applicator meets requirements specified under paragraph QUALIFICATION OF APPLICATOR.

Qualification of Engineer of Record

Certify that the Engineer of Record is fully qualified, competent, and currently licensed to practice in the project jurisdiction.

Wind Uplift Resistance; G classification, as applicable

SD-08 Manufacturer's Instructions

Modified Bitumen Membrane Application; G

Flashing; G

Cold Adhesive Applied Modified Bitumen Membrane; G

Base Sheet attachment, including pattern and frequency of mechanical attachments required in field of roof, corners, and perimeters to provide for the specified wind resistance.

Primer

Fasteners

Cold Weather Installation; G

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.

SD-09 Manufacturer's Field Reports

Manufacturer's Field Inspection Reports; G

SD-11 Closeout Submittals

Warranty

Information Card

Instructions To Government Personnel

Include copies of Safety Data Sheets for maintenance/repair materials.

Submit 20 year "No-Dollar-Limit" warranty for labor and materials.

1.3.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1.1 SS Heat Island Reduction

Product Test Reports for Credit SS Heat Island Reduction: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirement as specified.

1.3.1.2 IEQ Low Emitting Materials

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Modified bitumen sheet roofing system manufacturer must have a minimum of 5 years experience in manufacturing modified bitumen roofing products.

1.4.1.1 Manufacturer's Technical Representative

The manufacturer's technical representative must be thoroughly familiar with the products to be installed, installation requirements and practices, and with any special considerations in the geographical area of the project. The representative must perform field inspections and attend meetings as specified.

1.4.2 Qualification of Applicator

Roofing system applicator must be approved, authorized, or licensed in writing by the modified bitumen sheet roofing system manufacturer and have a minimum of five years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. The applicator must supply the names, locations and client contact information of five projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 Qualification of Engineer of Record

Engineer of Record must be currently licensed within the jurisdiction of the project.

Engineer of Record must be approved, authorized, and currently licensed by the state of Rhode Island, and have a minimum of five years experience as an approved Engineer for manufacturers of similar roof systems. Engineer of Record must supply the names and locations of five projects of similar size and scope for which he has provided engineering calculations using

the manufacturer's products submitted for this project within the previous three years. Engineer of Record must provide certified engineering calculations for:

Wind uplift requirements in accordance with Local and State codes

ASCE 7-16, in accordance with International Building Code.

Seismic requirements per local and state building codes

Seismic requirements per ICC IBC Chapter 16, Section 1608.3

Snow load requirements per ICC IBC Chapter 16 Section 1608.3 and Section 7 of ASCE 7-16

1.4.4 Wind Uplift Resistance

Provide a complete roof system assembly that is rated and installed to resist wind loads indicated and validated by uplift resistance testing in accordance with Factory Mutual (FM) test procedures. Do not install non-rated systems, except as approved by the Contracting Officer. Submit licensed engineer's Wind uplift calculations and substantiating data to validate any non-rated roof system. Base wind uplift measurements on a design wind speed as indicated on drawings in accordance with ASCE 7-16 and other applicable building code requirements.

1.4.5 Preroofing Conference

After approval of submittals and before performing roofing and insulation system installation work, hold a preroofing conference to review the following:

- a. Drawings, including Roof Plan, specifications and submittals related to the roof work
- b. Roof system components installation
- c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roof structure, and roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representatives
- d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing
- e. Quality control, (ARMA PMBRG98) plan for the roof system installation
- f. Field inspection and existing conditions report identifying all fire safety issues including exposed or concealed combustible materials, which may require additional protection during roof installation
- g. Safety requirements

Coordinate preroofing conference scheduling with the Contracting Officer. The conference must be attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work,

other trades interfacing with the roof work, designated safety personnel trained to enforce and comply with ASSP A10.24, Fire Marshall, and a representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with labels intact and legible. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification, the container must bear the specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.5.2 Storage

Protect materials against moisture absorption and contamination or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 50 degrees F for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof. Provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

Maintain a minimum distance of 35 foot for all stored flammable materials, including materials covered with shrink wraps, craft paper or tarps from all torch/welding applications.

Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

1.5.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials or applied roofing.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 40 degrees F, during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Follow manufacturer's printed instructions for Cold Weather Installation.

1.7 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counter flashing, per NRCA CONDET, and are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Apply roofing immediately following application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

1.8 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements. Provide a manufacturer's warranty that has no dollar limit, covers full system water-tightness, and has a minimum duration of 20 years.

1.8.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation in compliance with ASTM C1289, and accessories necessary for a watertight roof system construction. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the roof work. The warranty must state that:

- a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.
- b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.
- c. Upon completion of installation, and acceptance by the Contracting Officer, Architect, Construction Manager and Roofing System Engineer of Record, the manufacturer must supply the appropriate warranty to the Owner.
- d. Installer must submit a minimum two year warranty to the membrane manufacturer from the date of acceptance, with a copy to the Contracting Officer and Roofing System Engineer of Record.

1.8.2 Roofing System Installer Warranty

The roof system installer must warrant for a period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation,

accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.8.3 Continuance of Warranty

Repair or replacement work, ARMA 410BUR88, NRCA C3701 that becomes necessary within the warranty period and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.9 CONFORMANCE AND COMPATIBILITY

Provide the entire roofing and flashing system in accordance with specified and indicated requirements, including fire and wind resistance (ANSI/SPRI/FM 4435/ES-1) requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the NRCA Roofing and Waterproofing Manual, membrane manufacturer published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

1.10 ELIMINATION, PREVENTION OF FALL HAZARDS

PART 2 PRODUCTS

2.1 MATERIALS

Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Protect materials provided from defects and make suitable for the service and climatic conditions of the installation.

2.1.1 Sustainable Performance

Install a roof system that meets an overall performance as specified on the drawings or by insulation specified in other sections. Provide emittance and reflectance percentages, solar reflectance index values, to meet sustainable third party certification requirements for Heat Island Reduction.

2.2 MODIFIED BITUMEN SHEETS

Furnish a combination of specified materials that comprise the modified bitumen manufacturer's standard system of the number and type of plies specified. Provide materials suitable for the service and climatic conditions of the installation. Modified bitumen sheets must be watertight and visually free of pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Polymer modifier must comply with ARMA PMBRG98 and be uniformly dispersed throughout the sheet. Edges of sheet must be straight and flat.

- a. SBS Base Sheet: ASTM D6162/D6162M or ASTM D6164/D6164M, Type II, Grade S, minimum 120 mils thick.
- b. SBS Cap Sheet: ASTM D6162/D6162M or ASTM D6164/D6164M; Type II, Grade G, minimum 145 mils thick, and as required to provide specified fire safety rating.

2.3 BASE FLASHING MEMBRANE

Membrane manufacturer's standard, minimum two-ply modified bitumen membrane flashing system compatible with the roof membrane specified and as recommended in membrane manufacturer's published literature. Provide flashing membranes that meet or exceed the properties of the material standards specified for the modified bitumen base and cap sheet, except that flashing membrane thickness must be as recommended by the membrane manufacturer.

2.3.1 Fluid-Applied Flashing

All penetrations shall be flashed with two-part fluid applied with a stitch-bonded polyester reinforcing fabric. All flashed penetrations such as vent pipes are to be covered under the 20 year NDL warranty.

2.4 COLD-APPLIED MEMBRANE ADHESIVE

Membrane manufacturer's recommended cold process adhesive for application of the membrane plies.

2.5 MEMBRANE SURFACING

Provide modified bitumen roof membrane cap sheet with factory-applied granule surfacing of light color in order to achieve the required Solar Reflectance Index.

2.6 PRIMER

ASTM D41/D41M, or other primer compatible with the application and as approved in writing by the modified bitumen membrane manufacturer.

2.7 MODIFIED BITUMEN ROOF CEMENT

ASTM D4586/D4586M, Type II for vertical surfaces, Type I for horizontal surfaces, compatible with the modified bitumen roof membrane and as recommended by the modified bitumen membrane manufacturer.

2.8 CANT AND TAPERED EDGE STRIPS

Provide standard cants and tapered edge strips of the same material as the roof insulation or when roof insulation material is not available, provide pressure preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the manufacturer treated with bituminous impregnation, sizing, or waxing and fabricated to provide maximum 45 degree change in direction of membrane. Cant strips must be minimum 4 inch vertical height with 45 degree cant angle, except where clearance restricts height to lesser dimension. Taper edge strips at a rate of one to 1-1/2 inch per foot to a minimum of 1/8 inch of thickness. Provide kiln-dried preservative-treated wood cants, in compliance with requirements of Section 06 10 00 ROUGH CARPENTRY at base of wood nailers

set on edge and wood curbing and where otherwise indicated.

2.9 FASTENERS AND PLATES

Provide coated, corrosion-resistant fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470 and FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. For fastening of membrane or felts to wood materials, provide fasteners driven through 1 inch diameter metal discs, or one piece composite fasteners with heads not less than 1 inch in diameter or 1 inch square with rounded or 45 degree tapered corners.

2.9.1 Masonry or Concrete Walls and Vertical Surfaces

Use hardened steel nails or screws with flat heads, diamond shaped points, and mechanically deformed shanks not less than 1 inch long for securing felts, modified bitumen sheets, metal items, and accessories to masonry or concrete walls and vertical surfaces. Use power-driven fasteners only when approved in writing by the Contracting Officer.

2.9.2 Metal Plates

Provide flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470; not less than 2 inch in diameter. Form discs to prevent dishing or cupping.

2.10 PRE-MANUFACTURED ACCESSORIES

Pre-manufactured accessories must be manufacturer's standard for intended purpose, comply with applicable specification section, compatible with the membrane roof system and approved for use by the modified bitumen membrane manufacturer.

2.10.1 Pre-fabricated Curbs

Provide 20 gauge G90 galvanized curbs with minimum 4 inch flange for attachment to roof nailers. Curbs must be minimum height of 10 inch above the finished roof membrane surface.

2.11 WALKPADS

Provide roof walkpads that are polyester reinforced, granule-surfaced modified bitumen membrane material, minimum 197 mils thick, compatible with the modified bitumen sheet roofing and as recommended by the modified bitumen sheet roofing manufacturer. Panels must not exceed 4 foot in length. Other walkpad materials require approval of the Contracting Officer prior to installation.

2.12 ROOF INSULATION BELOW MODIFIED BITUMEN MEMBRANE SYSTEM

Provide insulation compatible with the roof membrane, approved by the membrane manufacturer and meeting all the requirements of as specified in Section 07 22 00 ROOF AND DECK INSULATION.

2.13 MEMBRANE LINER

Provide self-adhering modified bitumen underlayment conforming to

ASTM D1970/D1970M, EPDM membrane liner conforming to ASTM D4637/D4637M, or other waterproof membrane liner material as approved by the Contracting Officer.

2.13.1 Downspout and Gutter System

To be provided by Metal Roof Panel manufacturer, specified in 07 41 13, Metal Roof Panel.

PART 3 EXECUTION

3.1 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

- a. Do not install items that show visual evidence of biological growth.
- b. Curbs, cants, perimeter walls, roof penetrating components, and equipment supports are in place.
- c. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation. Joints in the substrate are sealed to prevent dripping of bitumen into building or down exterior walls.
- d. The plane of the substrate does not vary more than 1/4 inch within an area 10 by 10 foot when checked with a 10 foot straight edge placed anywhere on the substrate.
- e. Substrate is sloped as indicated to provide positive drainage.
- f. Walls and vertical surfaces are constructed to receive counter flashing, and will permit mechanical fastening of the base flashing materials.
- g. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inch above finished roofing surface.
- h. Protect all combustible materials and surfaces which may contain concealed combustible or flammable materials. All fire extinguishing equipment has been placed as specified.
- i. Treated wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of membrane, edging strips, attachment flanges of sheet metal, and roof fixtures. Surface-applied nailers are the same thickness as the roof insulation.
- j. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is 45 degrees and the height of the vertical leg is not less than 3-1/2 inch.
- k. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is being roofed over on the same day the insulation is installed.

1. Roof deck and framing are sloped as indicated to provide positive drainage.

3.2 PREPARATION

3.2.1 Protection of Property

3.2.1.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoists prior to starting the work. Lap protective coverings not less than 6 inch, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for the duration of the roofing work.

3.2.2 Equipment

3.2.2.1 Mechanical Application Devices

Mount mechanical application devices on pneumatic-tired wheels. Use devices designed and maintained to operate without damaging the insulation, roofing membrane, or structural components.

3.2.2.2 Electric-Heated Equipment

Provide adequate electrical service as required by manufacturer of electrical equipment to ensure against damage to equipment and property and to ensure proper application of roofing materials.

3.2.3 Priming of Surfaces

Prime all surfaces to be in contact with adhered membrane materials. Apply primer at the rate of 0.75 gallon per 100 sq. ft. or as recommended by modified bitumen sheet manufacturer's printed instructions to promote adhesion of membrane materials. Allow primer to dry prior to application of membrane materials to primed surface. Avoid flammable primer material conditions in torch applied membrane applications.

3.2.3.1 Priming of Metal Surfaces

Prime flanges of metal components to be embedded into the roof system prior to setting in bituminous materials or stripping into roofing system.

3.2.4 Membrane Preparation

Unroll modified bitumen membrane materials and allow to relax a minimum of 30 minutes prior to installation. In cold weather, adhere to membrane manufacturer's additional recommendations for pre-installation membrane handling and preparation. Inspect for damage, pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Edges of seams must be straight and flat so that they may be seamed to one another without forming fish mouths or wrinkles. Discard damaged or defective materials.

3.2.5 Substrate Preparation

Apply membrane to clean, dry surfaces only. Do not apply membrane to surfaces that have been wet by rain or frozen precipitation within the previous 12 hours. Provide cleaning and artificial drying with heated

blowers or torches as necessary to ensure clean, dry surface prior to membrane application. Torches may not be used to ensure clean, dry surfaces prior to membrane applications if the roof deck or materials used in the installation of the roofing system are combustible.

3.3 APPLICATION

Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer. Keep roofing materials dry before and during application. Complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperatures for asphalt. Provide temporary roofing and flashing as specified herein prior to application of permanent roofing system.

3.3.1 Phased Membrane Construction

Phased application of membrane plies is prohibited unless otherwise approved by the Contracting Officer and supported by the membrane manufacturer's written application instructions. If cap sheet installation is delayed, thoroughly clean the applied membrane material surface and dry immediately prior to cap sheet installation. Priming of the applied membrane surface may be required at the discretion of the Contracting Officer prior to cap sheet installation.

3.3.2 Temporary Roofing and Flashing

Provide watertight temporary roofing and flashing where considerable work by other trades, such as installing antennas, pipes, is to be performed on the roof or where construction scheduling or weather conditions require protection of the building's interior before permanent roofing system can be installed. Do not install temporary roofing over permanently installed insulation. Provide rigid pads for traffic over temporary roofing.

3.3.2.1 Removal

Completely remove temporary roofing and flashing before continuing with application of the permanent roofing system.

3.3.3 Application Method

3.3.3.1 Cold Adhesive Applied Modified Bitumen Membrane

Apply cold adhesive with airless sprayer or 1/4 inch saw-toothed rubber squeegee to prepared surfaces in accordance with membrane manufacturer's application instructions. Fully cover substrate with adhesive. Roll or lay membrane in adhesive in accordance with manufacturer's recommendations and within the time limitations of adhesive application. Broom the membrane to ensure full contact with adhesive. Seal laps with adhesive or by heat fusing with hot air welder as required by membrane manufacturer. Minimize traffic on installed membrane during the adhesive cure and set time.

3.3.4 Modified Bitumen Base Sheet

Fully adhere base sheets in accordance with membrane manufacturer's printed instructions. Apply cold adhesive with airless sprayer or a 1/4 inch saw-toothed rubber squeegee and at application rate recommended by the membrane manufacturer. Fully cover substrate with cold adhesive.

Ensure laps areas of base sheet are fully sealed. Roll and broom in the base sheet to ensure full contact with the adhesive application. On nailable substrates, mechanically fasten base sheet in conformance with specified wind resistance requirements and membrane manufacturer's printed instructions, and to include increased fastening frequency in corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate. Where applicable, mechanically fasten base sheet in conjunction with insulation to the substrate, in accordance with membrane manufacturers printed instructions. Apply sheets in a continuous operation. Apply sheets with side laps at a minimum of 2 inch unless greater side lap is recommended by the manufacturer's standard written application instructions. Provide end laps of not less than 6 inch and staggered a minimum of 36 inch. Apply sheets at right angles to the roof slope so that the direction of water flow is over and not against the laps. Extend base sheets approximately 2 inch above the top of cant strips at vertical surfaces and to the top of cant strips elsewhere. Trim base sheet to a neat fit around vent pipes, roof drains, and other projections through the roof. Application must be free of ridges, wrinkles, and buckles.

3.3.5 Modified Bitumen Membrane Application

Ensure proper sheet alignment prior to installation. Apply membrane layers perpendicular to slope of roof in shingle fashion to shed water, including application on areas of tapered insulation that change slope direction. Bucking or backwater laps are prohibited. Fully adhere membrane sheets to underlying substrate materials. Provide minimum 3 inch side laps and minimum 6 inch end laps and as otherwise required by membrane manufacturer. Stagger end laps minimum 36 inch. Offset side laps between membrane layers a minimum of 12 inch. Offset end laps between membrane layers a minimum of 36 inch. Install all membrane layers the same workday, unless supported otherwise by roof membrane manufacturer application instructions and approved by the Contracting Officer. Provide tight smooth laminations of each membrane layer without wrinkles, ridges, buckles, kinks, fishmouths, or voids. Ensure full membrane adhesion and full lap seals. Rework to seal any open laps prior to application of subsequent membrane layers. The completed membrane application must be free of surface abrasions, air pockets, blisters, ridges, wrinkles, buckles, kinks, fishmouths, voids, or open seams.

3.3.5.1 Cap Sheet Installation

Underlying applied membrane must be inspected and repaired free of damage, holes, puncture, gouges, abrasions, and any other defects, and free of moisture, loose materials, debris, sediments, dust, and any other conditions required by the membrane manufacturer prior to cap sheet installation. Do not apply cap sheet if rain or frozen precipitation has occurred within the previous 24 hours. Align cap membrane and apply by the specified method with the proper side and end lap widths. Cut at a 45 degree angle across selvage edge of cap membrane to be overlapped in end lap areas prior to applying overlapping cap membrane. Minimize traffic on newly installed cap sheet membrane.

3.3.5.2 Backnailing of Cap Sheet

Unless otherwise recommended by the modified bitumen membrane manufacturer and approved by the Contracting Officer, provide minimum 3-1/2 inch wide nailing strips matching insulation thickness and applied perpendicular to roof slope for backnailing of roof membrane. Space nailing strips as

recommended by the membrane manufacturer, but not exceeding 16 foot on center unless approved otherwise by the Contracting Officer. Coordinate the nailer installation with insulation requirements. Install the modified bitumen cap sheet to provide for end laps at nailer locations. Nail the modified bitumen cap sheet at the end lap area across the width of the sheet. Nail within 1 inch of each edge of the sheet and at 8 inch to 8-1/2 inch on center across the width of the sheet in a staggered fashion. Nails must have 1 inch diameter metal cap or be nailed through 1 inch diameter caps. Cover nails by overlapping adjacent upslope sheet at the end lap area.

3.3.6 Membrane Flashing

Apply two-ply modified bitumen strip flashing and sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Apply membrane flashing in accordance with the roof membrane manufacturers printed instructions and as specified. Cut at a 45 degree angle across terminating end lap area of cap membrane prior to applying adjacent overlapping cap membrane. Press flashing into place to ensure full adhesion and avoid bridging. Ensure full lap seal in all lap areas. Mechanically fasten top edge of modified bituminous base flashing 150 mm (6 inches) on center through minimum 1 inch diameter tin caps with fasteners of sufficient length to embed minimum one inch into attachment substrate. Apply matching granules in any areas of adhesive bleed out while the adhesive is still tacky. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components. Metal flashing per SMACNA 1793 guidelines and standards is specified under Section 07 60 00 FLASHING AND SHEET METAL. Do not set metal flashing in hot asphalt.

3.3.6.1 Membrane Strip Flashing

Set primed flanges of metal flashing in full bed of modified bituminous cement material and securely fasten through to attachment substrate. Strip-in with membrane flashing so that strip extends not less than 4 inch beyond outer edge of flange. Where multiple membrane stripping plies are installed, extend each additional stripping ply minimum 4 inch beyond edge of previous ply.

3.3.6.2 Pre-fabricated Curbs

Securely anchor prefabricated curbs to nailer or other base substrate and flash with modified bitumen membrane.

3.3.6.3 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories are set on the membrane, adhere walkpad material to bottom of accessories prior to setting on roofing membrane. Install set-on accessories to permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.3.6.4 Lightning Protection

Flash and attach lightning protection system components to the roof membrane in a manner acceptable to the roof membrane manufacturer.

3.3.7 Roof Walkpads

Install walkpads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the modified bitumen sheet roofing manufacturer's printed instructions. Provide minimum 6 inch separation between adjacent walkpads to accommodate drainage.

3.3.8 Correction of Deficiencies

Where any form of deficiency is found, take additional measures as deemed necessary by the Contracting Officer to determine the extent of the deficiency and perform corrective actions as directed by the Contracting Officer.

3.3.9 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.4 CORRECTION OF DEFICIENCIES

Where any form of deficiency is found, take additional measures as deemed necessary by the Contracting Officer to determine the extent of the deficiency and perform corrective actions as directed by the Contracting Officer.

3.5 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied modified bitumen roofing system from water intrusion.

3.5.1 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of modified bitumen roofing system in an effective manner. Seal off flutes in metal decking along the cutoff edge. Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.5.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashing can be applied. Remove temporary flashing before applying permanent flashing.

3.5.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.6 FIELD QUALITY CONTROL

Perform field tests in the presence of the Contracting Officer. Notify the Contracting Officer one day before performing tests.

3.6.1 Construction Monitoring

During progress of the roof work, make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

- a. Materials comply with the specified requirements.
- b. Materials are not installed in adverse weather conditions.

All materials are properly stored, handled and protected from moisture or other damages.

- c. Equipment is in working order. Metering devices are accurate.
- d. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

- (1) Nailers and blocking are provided where and as needed.

Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

- (2) The proper number, type, and spacing of fasteners are installed.

Membrane heating, hot mopping, or adhesive application is provided uniformly and as necessary to ensure full adhesion of roll materials. Asphalt is heated and applied within the specified temperature range.

The proper number and types of plies are installed, with the specified overlaps.

Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.

- (3) Lap areas of all plies are completely sealed.

Membrane is fully adhered without ridges, wrinkles, kinks, fishmouths, or other voids or delaminations.

Installer adheres to specified and detailed application parameters.

Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

Temporary protection measures are in place at the end of each work shift.

3.6.1.1 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of three times once per week during the installation for purposes of

reviewing materials installation practices and adequacy of work in place.

Inspections must occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections must not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer. After each inspection, submit a report, signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

Submit three signed copies of the manufacturer's field inspection reports to the Contracting Officer within one week of substantial completion.

3.6.2 Samples of Roofing

Take samples per ASTM D5147/D5147M, sized 4-inch by 40-inch cut across width of modified bitumen sheets as directed by the Contracting Officer. Cut samples will be examined by the Contracting Officer for specified number of plies, proper lap width, complete lap seal, full uniform adhesive compound application and adhesion, full bond between plies, harmful foreign materials, presence of moisture, and wet insulation. Where cuts are not retained by the Contracting Officer or disposed, set cut strip back in cut area in bed of modified bitumen cement. Repair area of cut with new minimum two-ply modified bitumen membrane patch.

3.7 INFRARED INSPECTION

Eight months after completion of the roofing system, the Contractor must inspect the roof surface using infrared (IR) scanning as specified in ASTM C1153. Where the IR inspection indicates moisture intrusion, replace wet insulation and damaged or deficient materials or construction in a manner to provide watertight construction and maintain the specified roof system warranties. Coordinate infrared inspections with building envelope commissioning activities.

3.8 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the modified bitumen membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

3.9 INFORMATION CARD

For each roof, furnish a typewritten information card for facility Records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.039 inch thick aluminum card for exterior display. Card must be 8 1/2 by 11 inch minimum, identifying facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing contractor identification and contact information; membrane manufacturer

warranty expiration, warranty reference number, and contact information.
Install card at roof top or access location as directed by the Contracting
Officer and provide a paper copy to the Contracting Officer.

-- End of Section --

SECTION 07 60 00

FLASHING AND SHEET METAL
05/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2605 (2020) Voluntary Specification,
Performance Requirements and Test
Procedures for Superior Performing Organic
Coatings on Aluminum Extrusions and Panels

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M (2014; Errata 1 2014; Errata 2 2020)
Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM B32 (2020) Standard Specification for Solder
Metal

ASTM B209 (2014) Standard Specification for Aluminum
and Aluminum-Alloy Sheet and Plate

ASTM B221 (2021) Standard Specification for Aluminum
and Aluminum-Alloy Extruded Bars, Rods,
Wire, Profiles, and Tubes

ASTM D1784 (2020) Standard Specification for Rigid
Poly(Vinyl Chloride) (PVC) Compounds and
Chlorinated Poly(Vinyl Chloride) (CPVC)
Compounds

ASTM D4586/D4586M (2007; E 2012; R 2012) Asphalt Roof
Cement, Asbestos-Free

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA 1793 (2012) Architectural Sheet Metal Manual,
7th Edition

1.2 GENERAL REQUIREMENTS

Finished sheet metal assemblies must form a weathertight enclosure without waves, warps, buckles, fastening stresses or distortion, while allowing for expansion and contraction without damage to the system. The sheet metal installer is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal modifications required to

accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous, uninterrupted roofing operations.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

- Exposed Sheet Metal Coverings; G
- Gravel Stops and fascia; G
- Base Flashing; G
- Counterflashing; G
- Flashing at Roof Penetrations and Equipment Supports; G
- Reglets; G
- Copings; G
- Drip Edges; G
- Eave Flashing; G
- Recycled Content; S

SD-04 Samples

- Finish Samples; G

SD-07 Certificates

- EPD(s); S
- Recycled Content; S
- Regional Material; S

SD-08 Manufacturer's Instructions

- Instructions for Installation; G
- Quality Control Plan; G

SD-10 Operation and Maintenance Data

- Cleaning and Maintenance; G

1.3.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of flashing products. Provide regional material certifications of applicable materials.

1.4 MISCELLANEOUS REQUIREMENTS

1.4.1 Product Data

Indicate thicknesses, dimensions, fastenings, anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.4.2 Finish Samples

Submit two color charts and two finish sample chips from manufacturer's standard color and finish options for each type of finish indicated.

1.4.3 Operation and Maintenance Data

Submit detailed instructions for installation and quality control during installation, cleaning and maintenance, for each type of assembly indicated.

1.5 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until installation.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content. Provide data for each product with recycled content, identifying percentage of recycled content.

2.2 MATERIALS

Do not use lead, lead-coated metal, or galvanized steel. Use any metal listed by SMACNA 1793 for a particular item, unless otherwise indicated. Provide materials, thicknesses, and configurations in accordance with SMACNA 1793 for each material. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items must be copper, and that contact between dissimilar metals must be

avoided.

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used, except as follows:

2.2.1 Exposed Sheet Metal Items

Must be of the same material. Consider the following as exposed sheet metal: gravel stops and fascia; cap, base, and eave flashings and related accessories.

2.2.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces.

2.2.3 Aluminum Alloy Sheet and Plate

Provide in accordance with ASTM B209 color as indicated on drawings form alloy, and temper appropriate for use. Provide material not less than 0.032-in in thickness.

2.2.3.1 Alclad

When fabricated of aluminum, fabricate the following items with Alclad 3003, Alclad 3004, or Alclad 3005, clad on both sides unless otherwise indicated.

- a. Gravel stops and
- b. Fascia
- c. Flashing

2.2.4 Finishes

Provide exposed exterior sheet metal and aluminum with a baked on, factory applied color coating of 70% polyvinylidene fluoride (PVF2) or approved equal fluorocarbon coating. Dry film thickness of coatings must be 0.8 to 1.3 mils. Finish to meet AAMA 2605 performance. Color as indicated on the Drawings. Field applications of color coatings are prohibited and will be rejected.

2.2.5 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B221.

2.2.6 Solder

Provide in accordance with ASTM B32, 95-5 tin-antimony.

2.2.7 Reglets

2.2.7.1 Polyvinyl Chloride Reglets

Provide in accordance with ASTM D1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness.

2.2.7.2 Metal Reglets

Provide factory fabricated caulked type or friction type reglets with a minimum opening of 1/4 inch and a depth of 1-1/4 inch, as approved.

2.2.7.2.1 Caulked Reglets

Provide with rounded edges, temporary reinforcing cores, and accessories as required for securing to adjacent construction. Provide built-up mitered corner pieces for inside and outside corners.

2.2.8 Copings

Unless otherwise indicated, provide copings in copper sheets, 8 or 10 feet long, joined by a 3/4 inch locked and soldered seam.

2.2.9 Bituminous Plastic Cement

Provide in accordance with ASTM D4586/D4586M, Type I.

2.2.10 Fasteners

Use the same metal as, or a metal compatible with the item fastened. Use stainless steel fasteners to fasten. Confirm compatibility of fasteners and items to be fastened to avoid galvanic corrosion due to dissimilar materials.

2.2.11 Downspout and Gutter System

As specified in 07 41 13, METAL ROOF PANEL.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.2 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inches. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inch on center and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work. Secure flashing at one-half the normal interval to ensure a wind-resistant installation.

3.1.3 Cleats

Provide cleats for sheet metal 18 inches and over in width. Space cleats evenly not over 12 inches on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Where the fastening is to be made to concrete or masonry, use screws and drive in expansion shields set in concrete or masonry. Pre-tin cleats for soldered seams.

3.1.4 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 0.040 inches or less in thickness.

3.1.5 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.5.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

3.1.5.2 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inches.

3.1.5.3 Loose-Lock Expansion Seams

Not less than 3 inches wide; provide minimum one inch movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 1/8 inch thick bed.

3.1.5.4 Standing Seams

Not less than one inch high, double locked without solder.

3.1.5.5 Flat Seams

Make seams in the direction of the flow.

3.1.6 Soldering

Where soldering is specified, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Pre-tin edges of sheet metal before soldering is begun. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.6.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pre-tinned. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.7 Welding and Mechanical Fastening

Use welding for aluminum of thickness greater than 0.040 inch. Aluminum 0.040 inch or less in thickness must be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with sealant as recommended by the aluminum manufacturer.

3.1.7.1 Welding of Aluminum

Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to AWS D1.2/D1.2M.

3.1.7.2 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 12 inches maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 2 inches from the end of the overlapping sheet.

3.1.8 Protection from Contact with Dissimilar Materials

3.1.8.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

3.1.8.2 Aluminum

Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint. Aluminum may be used over concrete construction, provided that required reglets are of stainless steel and aluminum surface in contact with concrete or masonry is coated with bituminous paint or zinc chromate primer.

3.1.8.3 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.8.4 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.9 Expansion and Contraction

Provide expansion and contraction joints at not more than 32 foot intervals for aluminum and at not more than 40 foot intervals for other metals. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly. Join extruded aluminum gravel stops and fascia by expansion and contraction joints spaced not more than 12 feet apart.

3.1.10 Base Flashing

Extend up vertical surfaces of the flashing not less than 8 inches and not less than 4 inches under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 6 inches. Overlap the flashing strips with the previously laid flashing not less than 3 inches. Fasten the strips at their upper edge to the deck. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 6 inches on center with a minimum of 2 inch lap of any surface. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of curbs, and similar vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 4.5 inches at the lower side of vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners. Do not use metal base flashing on built-up roofing.

3.1.11 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 9 to 10 inches above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inches. Fold the exposed edges of counterflashings 1/2 inch. Where stepped counterflashings are required, they may be installed in short lengths a minimum 8 inches by 8 inches or may be of the preformed single piece type. Provide end laps in counterflashings not less than 3 inches and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10 feet. Form flashings to the required shapes before installation. Factory form corners not less than 12 inches from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18 inches apart; on short runs, place wedges closer together. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 1/4

inch and extend not less than 2 inches into the walls. Install counterflashing to provide a spring action against base flashing. Where bituminous base flashings are provided, extend down the counter flashing as close as practicable to the top of the cant strip. Factory form counter flashing to provide spring action against the base flashing.

3.1.12 Metal Reglets

Keep temporary cores in place during installation. Ensure factory fabricated caulked type or friction type, reglets have a minimum opening of 1/4 inch and a minimum depth of 1-1/4 inch, when installed.

3.1.12.1 Caulked Reglets

Wedge flashing in reglets with lead wedges every 18 inches, caulked full and solid with an approved compound.

3.1.13 Polyvinyl Chloride Reglets for Temporary Construction

Rigid polyvinyl chloride reglets may be provided in lieu of metal reglets for temporary construction.

3.1.14 Gravel Stops and fascia

Prefabricate in the shapes and sizes indicated and in lengths not less than 8 feet. Extend flange at least 4 inches onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascia after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fascia on both sides with an asphalt primer. After primer has dried, set flange on roofing membrane and strip-in. Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 1.5 inch long spaced not more than 3 inches on center, in two staggered rows.

3.1.14.1 Edge Strip

Hook the lower edge of fascia at least 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inches maximum on center. Where fastening is made to concrete or masonry, use screws spaced 12 inches on center driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 1/16 inch thick compatible spacer or washers.

3.1.14.2 Joints

Leave open the section ends of gravel stops and fascia 1/4 inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4 inches set laps in plastic cement. Face nailing will not be permitted. Install prefabricated aluminum gravel stops and fascia in accordance with the manufacturer's printed instructions and details.

3.1.15 Metal Drip Edges

Provide a metal drip edge, designed to allow water run-off to drip free of

underlying construction, at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 3 inches and secure with compatible nails spaced not more than 10 inches on center along upper edge.

3.1.16 Eave Flashing

One piece in width, applied in 8 to 10 foot lengths with expansion joints spaced as specified in paragraph EXPANSION AND CONTRACTION. Provide a 3/4 inch continuous fold in the upper edge of the sheet to engage cleats spaced not more than 10 inches on center. Locate the upper edge of flashing not less than 18 inches from the outside face of the building, measured along the roof slope. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia. Where eave flashing intersects metal valley flashing, secure with one inch flat locked joints with cleats that are 10 inches on center.

3.1.17 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, dormers and small decks with metal sheets of the material used for flashing; maximum size of sheets, 16 by 18 inches. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams as recommended by aluminum manufacturer. Provide an underlayment of roofing felt for all sheet metal covering.

3.1.18 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

3.1.19 Single Pipe Vents

See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 3 inches on center. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inches. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4 inches roof flange in bituminous plastic cement and nailed 3 inches on center. Extend sleeve a minimum of 8 inches above the roof deck and lapped a minimum of 3 inches by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant.

3.1.20 Copings

Provide coping with locked and soldered seam. Terminate outer edges in edge strips. Install with sealed lap joints as indicated.

3.2 PAINTING

Touch ups in the field may be applied only after metal substrates have been cleaned and pretreated in accordance with manufacturer's written instructions and products.

Field-paint sheet metal for separation of dissimilar materials.

3.2.1 Aluminum Surfaces

Clean with solvent and apply one coat of zinc-molybdate primer and one coat of aluminum paint.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Remove work that is not in compliance with the contract and replace or correct. Include quality control, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.
- b. Verification that specified material is provided and installed.
- c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items		Aluminum, inch			
Flashings:					
Base		.040			

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items		Aluminum, inch			
Cap (Counter-flashing)		.032			
Gravel stops and fascia:					
Extrusions		.075			
Sheets, smooth		.050			
Edge strip		.050			
(a) Brass.					
(b) May be lead weighing 4 pounds per square foot.					
(c) May be polyvinyl chloride.					
(d) 2.5 pound minimum lead sleeve with 4 inch flange. Where lead sleeve is impractical, refer to paragraph SINGLE PIPE VENTS for optional material.					

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Flashings			
Base	One inch 3 inch lap for expansion joint	One inch flat locked, soldered; sealed; 3 inch lap for expansion joint	Aluminum manufacturer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound.

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Reglets		--	Seal reglet groove with joint sealing compound.
Edge strip		Butt	--
Gravel stops:			
Extrusions		Butt with 1/2 inch space	Use sheet flashing beneath and a cover plate
Sheet, smooth		Butt with 1/4 inch space	Use sheet flashing backup plate.
(a) Provide a 3 inch lap elastomeric flashing with manufacturer's recommended sealant.			
(b) Seal Polyvinyl chloride reglet with manufacturer's recommended sealant.			

-- End of Section --

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SECTION 07 84 00

FIRESTOPPING
05/10

PART 1 GENERAL

1.1 SUMMARY

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

- a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.
- b. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E119	(2020) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E814	(2013a; R 2017) Standard Test Method for Fire Tests of Penetration Firestop Systems
ASTM E1399/E1399M	(1997; R 2017) Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E1966	(2015; R 2019) Standard Test Method for Fire-Resistive Joint Systems
ASTM E2174	(2020a) Standard Practice for On-Site Inspection of Installed Firestop Systems

ASTM E2307	(2020) Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus
ASTM E2393	(2020) Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
FM GLOBAL (FM)	
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
INTERNATIONAL CODE COUNCIL (ICC)	
ICC IBC	(2021) International Building Code
UNDERWRITERS LABORATORIES (UL)	
UL 723	(2021) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 1479	(2015) Fire Tests of Through-Penetration Firestops
UL 2079	(2015; Reprint Jul 2020) Tests for Fire Resistance of Building Joint Systems
UL Fire Resistance	(2014) Fire Resistance Directory

1.3 SEQUENCING

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping. Apply firestopping materials at building joints and construction gaps, prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

A single complete submittal including Shop Drawings, Product Data, UL details must be provided for all firestopping systems throughout entire project.

SD-02 Shop Drawings

Firestopping System; G

SD-03 Product Data

Firestopping Materials; G

SD-06 Test Reports

Inspection; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

Inspector Qualifications; G

Firestopping Materials; G

Installer Qualifications; G

1.4.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.4.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.4.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of firestopping products.

Provide regional material certifications of applicable materials.

1.4.1.3 IEQ Low Emitting Materials

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualifications

All firestopping systems shall be performed by one experienced firestop contractor. Experienced firestop contractor is defined as following:

1. FM Research approved in accordance with FM 4991, or

2. Operating as a UL Certified Firestop Contractor, or
3. A contractor completed the manufacturer accredited firestop specialty contractor program. Certified, licensed or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years of experience in the installation of manufacturer's products in accordance with specified requirements. Submit documentation of this experience. A manufacturer's willingness to sell its firestopping products to the contractor or to an installer engaged by the Contractor does not in itself confer installer qualifications on the buyer. Individual building system subcontractor, such as Mechanical, Electrical, Plumbing, Gypsum wall, etc., is not permitted to install firestopping systems.

1.5.2 Inspector Qualifications

The inspector shall have a minimum of two years experience in construction field inspections of firestopping systems, products, and assemblies. The inspector shall be completely independent of, and divested from, the installer, the manufacturer, and the supplier of any material or item being inspected. The inspector shall not be a competitor of the installer, the contractor, the manufacturer, or supplier of any material or item being inspected. Include in the qualifications submittal a notarized statement assuring compliance with the requirements stated herein.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements and temperatures in accordance with manufacturer requirements. Remove damaged or deteriorated materials from the site. Use materials within their indicated shelf life.

PART 2 PRODUCTS

2.1 FIRESTOPPING SYSTEM

Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal must indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

Also, submit a written report indicating locations of and types of penetrations and types of firestopping used at each location; record type by UL list printed numbers.

2.2 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic

manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.2.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

2.2.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment.

2.2.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected. Where required, firestop systems shall also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected.

2.2.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph SUMMARY, shall provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E814 or UL 1479. Fire resistance ratings shall be as follows:

2.2.3.1.1 Penetrations of Fire Resistance Rated Walls and Partitions

Rating of wall or partition being penetrated.

2.2.3.1.2 Penetrations of Fire Resistance Rated Floors, Floor-Ceiling Assemblies and the Ceiling Membrane of Roof-Ceiling Assemblies

Rating of the assembly being penetrated. Where the penetrating item is outside of a wall cavity the F rating must be equal to the fire resistance rating of the floor penetrated, and the T rating shall be in accordance with the requirements of ICC IBC.

2.2.3.1.3 Penetrations of Fire and Smoke Resistance Rated Walls, Floors, Floor-Ceiling Assemblies, and the ceiling membrane of Roof-Ceiling Assemblies

Rating of the assembly being penetrated.

2.2.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph SUMMARY, and gaps such as those between floor slabs and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E119, ASTM E1966 or UL 2079 to meet the required fire resistance rating. Curtain wall joints shall be provided with firestopping materials and systems that have been tested in

accordance with ASTM E2307 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E1399/E1399M or UL 2079. All joints at the intersection of the top of a fire resistance rated wall and the underside of a fire-rated floor, floor ceiling, or roof ceiling assembly shall provide a minimum class II movement capability.

2.2.4 Material Certification

Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification of compliance with UL 1479.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping must be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement must be sound and capable of supporting device. Prepare surfaces as recommended by the manufacturer.

3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4 inches or more in any direction must be capable of supporting the same load as the floor is designed to support or be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.
- d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.
- e. Construction joints in floors and fire rated walls and partitions.
- f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for

firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Install and firestop fire dampers in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION. Firestop installed with fire damper must be tested and approved for use in fire damper system. Firestop installed with fire damper must be tested and approved for use in fire damper system.

3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products and devices as indicated.

3.2.3.1 Re-Enterable Devices

Firestopping devices shall be pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, additions or changes without the need to remove or replace any firestop materials. Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants; while maintaining "L" rating of <10 cfm/sf measured at ambient temperature and 400 degrees F at 0 percent to 100 percent visual fill.

3.2.3.2 Re-Sealable Products

Provide firestopping pre-manufactured modular products, containing self-sealing intumescent inserts. Firestopping products shall allow for cable moves, additions or changes. Devices shall be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants.

3.3 INSPECTION

For Navy projects, install one of each type of penetration and have it inspected and accepted by the Naval Facilities Engineering Systems Command, Fire Protection Engineer prior to the installation of the remainder of the penetrations. At this inspection, the manufacturer's technical representative of the firestopping material shall be present. For all projects, the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the Contracting Officer. The inspector must inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

3.3.1 Inspection Standards

Inspect all firestopping in accordance with ASTM E2393 and ASTM E2174 for firestop inspection, and document inspection results to be submitted.

3.3.2 Inspection Reports

Submit inspection report stating that firestopping work has been inspected

and found to be applied according to the manufacturer's recommendations
and the specified requirements.

-- End of Section --

SECTION 07 92 00

JOINT SEALANTS

08/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C509	(2006; R 2015) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C734	(2015; R 2019) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C919	(2012; R 2017) Standard Practice for Use of Sealants in Acoustical Applications
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C1193	(2013) Standard Guide for Use of Joint Sealants
ASTM C1311	(2014) Standard Specification for Solvent Release Agents
ASTM C1521	(2013) Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
ASTM D217	(2019b) Standard Test Methods for Cone Penetration of Lubricating Grease
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1667	(2017) Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2452	(2015; R 2019) Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
ASTM D2453	(2015; R 2020; E 2020) Standard Test Method for Shrinkage and Tenacity of Oil- and Resin-Base Caulking Compounds
ASTM E84	(2020) Standard Test Method for Surface

Burning Characteristics of Building
Materials

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350

(2010; Version 1.1) Standard Method for
the Testing and Evaluation of Volatile
Organic Chemical Emissions from Indoor
Sources using Environmental Chambers

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168

(2017) Adhesive and Sealant Applications

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants; G

Primers; G

Bond Breakers; G

Backstops; G

SD-06 Test Reports

Field Adhesion; G

SD-07 Certificates

EPD(s); S

VOC Emissions; S

VOC Content; S

Indoor Air Quality For Interior Sealants; S

Indoor Air Quality For Interior Floor Joint Sealants; S

Indoor Air Quality For Interior Acoustical Sealants; S

Indoor Air Quality For Interior Caulking; S

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 IEQ Low-Emitting Materials

For Adhesives and Sealants submit VOC statement indicating compliance with the;

- a. VOC Emissions Evaluation
- b. VOC Content Evaluation

1.3 PRODUCT DATA

Include storage requirements, shelf life, curing time, instructions for mixing and application, and accessories. Provide manufacturer's Safety Data Sheets (SDS) for each solvent, primer and sealant material proposed.

1.4 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.5 DELIVERY AND STORAGE

Deliver materials to the jobsite in unopened manufacturers' sealed shipping containers, with brand name, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Handle and store materials in accordance with manufacturer's printed instructions. Prevent exposure to foreign materials or subjection to sustained temperatures exceeding 90 degrees F or lower than 0 degrees F. Keep materials and containers closed and separated from absorptive materials such as wood and insulation.

1.6 QUALITY ASSURANCE

1.6.1 Compatibility with Substrate

Verify that each sealant is compatible for use with each joint substrate in accordance with sealant manufacturer's printed recommendations for each application.

1.6.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

1.6.3 Mock-Up

Provide a mock-up of each type of sealant using materials, colors, and techniques approved for use on the project. Approved mock-ups may be incorporated into the Work.

1.6.4 Adhesion

Provide in accordance with ASTM C1193 or ASTM C1521.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant products that have been tested, found suitable, and documented as such by the manufacturer for the particular substrates to which they will be applied.

2.1.1 Interior Sealants

Provide ASTM C920, Type S or M, Grade NS, Class 12.5, Use NT. Provide sealant products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide certification or validation of indoor air quality for interior sealants. Location(s) and color(s) of sealant for the following. Note, color "as selected" refers to manufacturer's full range of color options

LOCATION	COLOR
a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface mounted equipment and fixtures, and similar items.	As selected
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	White
c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	White
d. Joints between edge members for acoustical tile and adjoining vertical surfaces.	White
e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	White
f. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where non-planar tile surfaces meet.	White
g. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.	White
h. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	White

2.1.2 Exterior Sealants

For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s)

of sealant as follows. Note, color "as selected" refers to manufacturer's full range of color options:

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	As selected
b. Expansion and control joints.	As selected
c. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	As selected
d. Voids where items pass through exterior walls.	As selected
e. Metal-to-metal joints where sealant is indicated or specified.	As selected
f. Joints between ends of gravel stops, fascia, copings, and adjacent walls.	As selected

2.1.3 Floor Joint Sealants

ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide sealant products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide certification or validation of indoor air quality for interior floor joint sealants. Provide location(s) and color(s) of sealant as follows. Note, color "as selected" refers to manufacturer's full range of color options:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	As selected
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	As selected

2.1.4 Acoustical Sealants

Rubber or polymer based acoustical sealant in accordance with ASTM C919 to have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Provide non-staining acoustical sealant with a consistency of 250 to 310 when tested in

accordance with ASTM D217. Acoustical sealant must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734. Provide sealant products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide certification or validation of indoor air quality for interior acoustical sealants.

2.1.5 Preformed Sealants

Provide preformed sealants of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealants capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, sealants must be non-bleeding and have no loss of adhesion.

2.2 PRIMERS

Non-staining, quick drying type and consistency as recommended by the sealant manufacturer for the particular application. Provide primers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.3 BOND BREAKERS

Type and consistency as recommended by the sealant manufacturer to prevent adhesion of the sealant to the backing or to the bottom of the joint. Provide bond breakers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.4 BACKSTOPS

Provide glass fiber roving, neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Provide backstop material that is compatible with sealant. Do not use oakum or other types of absorptive materials as backstops.

2.4.1 Rubber

Provide in accordance with ASTM D1056, Type 2, closed cell, Class A, round cross section for cellular rubber sponge backing.

2.4.2 PVC

Provide in accordance with ASTM D1667, Grade VO 12, open-cell foam, round cross section for polyvinyl chloride (PVC) backing.

2.4.3 Synthetic Rubber

Provide in accordance with ASTM C509, Option I, Type I preformed rods or tubes for synthetic rubber backing.

2.4.4 Neoprene

Provide in accordance with ASTM D1056, closed cell expanded neoprene cord

Type 2, Class C, Grade 2C2 for neoprene backing.

2.4.5 Butyl Rubber Based

Provide in accordance with ASTM C1311, from a single component, with solvent release. Color as selected from manufacturer's full range of color choices.

2.4.6 Silicone Rubber Base

Provide in accordance with ASTM C920, from a single component, with solvent release, Non-sag, Class 25. Color as selected from manufacturer's full range of color choices.

2.5 CAULKING

For interior use and only where there is little or no anticipated joint movement. Provide in accordance with ASTM D2452 and ASTM D2453, for oil and resin-based caulking. Provide products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide certification or validation of indoor air quality for interior caulking.

2.6 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer and in accordance with environmental requirements herein. Protect adjacent aluminum and bronze surfaces from solvents. Provide solvents for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

Perform a field adhesion test in accordance with manufacturer's instructions and ASTM C1193, Method A or ASTM C1521, Method A, Tail Procedure. Remove sealants that fail adhesion testing; clean substrates, reapply sealants, and re-test. Test sealants adjacent to failed sealants. Submit field adhesion test report indicating tests, locations, dates, results, and remedial actions taken.

3.2 SURFACE PREPARATION

Prepare surfaces according to manufacturer's printed installation instructions. Clean surfaces from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would destroy or impair adhesion. Remove oil and grease with solvent; thoroughly remove solvents prior to sealant installation. Wipe surfaces dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, provide in accordance with sealant manufacturer's printed instructions for each specific surface.

3.2.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical

or would damage finished work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue free solvent. Remove resulting debris and solvent residue prior to sealant installation.

3.2.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive prior to sealant application. For removing protective coatings and final cleaning, use non-staining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.2.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity. Remove resulting debris prior to sealant installation.

3.2.4 Wood Surfaces

Ensure wood surfaces that will be in contact with sealants are free of splinters, sawdust and other loose particles.

3.3 SEALANT PREPARATION

Do not add liquids, solvents, or powders to sealants. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.4 APPLICATION

3.4.1 Joint Width-To-Depth Ratios

Acceptable Ratios:

<u>JOINT WIDTH</u>	<u>JOINT DEPTH</u>	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
over 1/2 inch to 1 inch	1/2 inch	5/8 inch

<u>JOINT WIDTH</u>	<u>JOINT DEPTH</u>	
	Minimum	Maximum
Over 1 inch	prohibited	

Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is prohibited at metal surfaces.

3.4.2 Unacceptable Sealant Use

Do not install sealants in lieu of other required building enclosure weatherproofing components such as flashing, drainage components, and joint closure accessories, or to close gaps between walls, floors, roofs, windows, and doors, that exceed acceptable installation tolerances. Remove sealants that have been used in an unacceptable manner and correct building enclosure deficiencies to comply with contract documents requirements.

3.4.3 Masking Tape

Place masking tape on the finished surface on one or both sides of joint cavities to protect adjacent finished surfaces from primer or sealant smears. Remove masking tape within 10 minutes of joint filling and tooling.

3.4.4 Backstops

Provide backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide joints in specified depths. Provide backstops where indicated and where backstops are not indicated but joint cavities exceed the acceptable maximum depths specified in JOINT WIDTH-TO-DEPTH RATIOS Table.

3.4.5 Primer

Clean out loose particles from joints immediately prior to application of. Apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's printed instructions. Do not apply primer to exposed finished surfaces.

3.4.6 Bond Breaker

Provide bond breakers to surfaces not intended to bond in accordance with, sealant manufacturer's printed instructions for each type of surface and sealant combination specified.

3.4.7 Sealants

Provide sealants compatible with the material(s) to which they are applied. Do not use a sealant that has exceeded its shelf life or has jelled and cannot be discharged in a continuous flow from the sealant gun. Apply sealants in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Work sealant into joints so as to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Apply sealant

uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply additional sealant, and tool smooth as specified. Apply sealer over sealants in accordance with the sealant manufacturer's printed instructions.

3.5 PROTECTION AND CLEANING

3.5.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled and no residual tape marks remain.

3.5.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

- a. Masonry and Other Porous Surfaces: Immediately remove fresh sealant that has been smeared on adjacent masonry, rub clean with a solvent, and remove solvent residue, in accordance with sealant manufacturer's printed instructions. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding. Remove resulting debris.
- b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent moistened cloth. Remove solvent residue in accordance with solvent manufacturer's printed instructions.

-- End of Section --

SECTION 08 11 13

STEEL DOORS AND FRAMES

08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding
Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M (2020) Standard Specification for Steel
Sheet, Zinc-Coated (Galvanized) or
Zinc-Iron Alloy-Coated (Galvannealed) by
the Hot-Dip Process

ASTM A879/A879M (2012; R 2017) Standard Specification for
Steel Sheet, zinc Coated by the
Electrolytic Process for Applications
Requiring Designation of the Coating Mass
on Each Surface

ASTM A924/A924M (2020) Standard Specification for General
Requirements for Steel Sheet,
Metallic-Coated by the Hot-Dip Process

ASTM C578 (2019) Standard Specification for Rigid,
Cellular Polystyrene Thermal Insulation

ASTM C591 (2020) Standard Specification for Unfaced
Preformed Rigid Cellular Polyisocyanurate
Thermal Insulation

ASTM C612 (2014; R 2019) Standard Specification for
Mineral Fiber Block and Board Thermal
Insulation

ASTM D2863 (2019) Standard Test Method for Measuring
the Minimum Oxygen Concentration to
Support Candle-Like Combustion of Plastics
(Oxygen Index)

ASTM E1300 (2016) Standard Practice for Determining
Load Resistance of Glass in Buildings

ASTM F2248 (2012) Standard Practice for Specifying an
Equivalent 3-Second Duration Design
Loading for Blast Resistant Glazing
Fabricated with Laminated Glass

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115 (2016) Hardware Preparation in Steel Doors
and Steel Frames

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (2019) Standard for Fire Doors and Other
Opening Protectives

NFPA 252 (2017) Standard Methods of Fire Tests of
Door Assemblies

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 113 (2013; R2018) Standard Practice for
Determining the Steady-State Thermal
Transmittance of Steel Door and Frame
Assemblies

SDI/DOOR A250.4 (2018) Test Procedure and Acceptance
Criteria for Physical Endurance for Steel
Doors, Frames and Frame Anchors

SDI/DOOR A250.6 (2015) Recommended Practice for Hardware
Reinforcing on Standard Steel Doors and
Frames

SDI/DOOR A250.8 (2017) Specifications for Standard Steel
Doors and Frames

SDI/DOOR A250.11 (2012) Recommended Erection Instructions
for Steel Frames

UNDERWRITERS LABORATORIES (UL)

UL 10C (2016) UL Standard for Safety Positive
Pressure Fire Tests of Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are for Contractor Quality Control
approval. Submittals with an "S" are for inclusion in the Sustainability
eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING.
Submit the following in accordance with Section 01 33 00 SUBMITTAL
PROCEDURES:

SD-02 Shop Drawings

Doors; G

Frames; G

Accessories

Schedule of Doors; G

Schedule of Frames; G

SD-03 Product Data

Doors; G

Frames; G

Accessories

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for steel door and steel frame products.

Provide regional material certifications of applicable materials.

1.2.1.3 IEQ Low Emitting Materials

For doors and frames applied inside the weatherproofing system - submit statement indicating compliance with the;

a. VOC Emissions Evaluation

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00 DOOR HARDWARE. Undercut where indicated. Provide exterior doors with top edge closed flush and sealed to prevent water intrusion. Provide doors at 1-3/4 inch thick, unless otherwise indicated. Provide door material that uses a minimum of 25 percent recycled content. Provide data indicating percentage of recycled content for steel door product. Provide exterior glazing in accordance with ASTM F2248 and ASTM E1300.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Extra heavy Duty Doors

SDI/DOOR A250.8, Level 3, physical performance Level A, Model 1 with core construction as required by the manufacturer for interior doors, of size(s) and design(s) indicated.

2.1.1.2 Maximum Duty Doors

SDI/DOOR A250.8, Level 4, physical performance Level A, Model 1 with core construction as required by the manufacturer for exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners must be filled with board insulation.

2.2 INSULATED STEEL DOOR SYSTEMS

Provide insulated steel doors and frames in accordance with SDI/DOOR 113 at entrances to dwelling units and where indicated. Meet energy requirements including Solar Heat Gain Coefficient (SHGC) and U-factor. Provide insulated steel doors with a core of polyurethane foam; face sheets, edges, and frames of galvanized steel not lighter than 23 gage, 16 gage, and 16 gage respectively; magnetic weatherstripping; nonremovable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Provide to doors and frames a phosphate treatment, rust-inhibitive primer, and baked acrylic enamel finish. Test doors in accordance with SDI/DOOR A250.4 and meet the requirements for Level C. Prepare doors to receive specified hardware. Provide doors 1-3/4 inch thick.

2.3 ACCESSORIES

2.3.1 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00 DOOR HARDWARE provide overlapping steel astragals with the doors.

2.3.2 Moldings

Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings.

2.4 INSULATION CORES

Provide insulating cores at all exterior doors, and provide an apparent U-factor as indicated on drawings in accordance with SDI/DOOR 113 and conforming to:

- a. Rigid Cellular Polyisocyanurate Foam: ASTM C591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D2863; or
- b. Rigid Polystyrene Foam Board: ASTM C578, Type I or II; or
- c. Mineral board: ASTM C612, Type I.

2.5 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 4, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, transoms, cased openings, unless otherwise indicated. Provide frame product that uses a minimum of 25 percent recycled content. Provide data indicating percentage of recycled content for steel frame product.

2.5.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

2.5.2 Mullions and Transom Bars

Provide mullions and transom bars of closed or tubular construction with heads and jambs butt-welded together. Bottom of door mullions must have adjustable floor anchors and spreader connections.

2.5.3 Stops and Beads

Provide form and loose stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.5.4 Cased Openings

Fabricate frames for cased openings of same material, gage, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.

2.5.5 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated not lighter than 18 gage.

2.5.5.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

- a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;
- b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

2.5.5.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

2.6 FIRE DOORS AND FRAMES

Provide fire doors and frames in accordance with NFPA 80 and this specification.

2.6.1 Labels

Provide fire doors and frames bearing the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing must be in accordance with NFPA 252 or UL 10C. Provide labels that are metal with raised letters, bearing the name or file number of the door and frame manufacturer. Labels must be permanently affixed at the factory to frames and to the hinge edge of the door. Do not paint door and labels.

2.7 EXTERIOR FRAMES

Provide thermal insulation in all exterior frames. Provide frames of a minimum Level 4, with frames of a minimum thickness of 0.067 inch, 14 gage.

2.8 HARDWARE PREPARATION

Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to ANSI/BHMA A156.115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Punch door frames, with the exception of frames that will have weatherstripping gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.9 FINISHES

2.9.1 Factory-Primed Finish

Thoroughly clean all surfaces of doors and frames then chemically treat and factory prime with a rust inhibiting coating as specified in

SDI/DOOR A250.8.

2.9.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A924/A924M and ASTM A653/A653M. The coating weight must meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8.

2.9.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A879/A879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI/DOOR A250.8.

2.10 FABRICATION AND WORKMANSHIP

Provide finished doors and frames that are strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Provide molded members that are clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints must be well formed and in true alignment. Conceal fastenings where practicable. On wraparound frames for masonry partitions, provide a throat opening 1/8 inch larger than the actual masonry thickness. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive caulking compound.

2.11 PROVISIONS FOR GLAZING

Materials are specified in Section 08 81 00, GLAZING.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Where frames require ceiling struts or overhead bracing, anchor frames to the struts or bracing.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same

type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly.
Remove mastic smears and other unsightly marks.

-- End of Section --

SECTION 08 11 16

ALUMINUM DOORS AND FRAMES

05/17, CHG 2: 11/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF45 (2003; Reaffirmed 2009) Designation System
for Aluminum Finishes

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP (2013) Energy Standard for Buildings
Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon
Structural Steel

ASTM B209 (2014) Standard Specification for Aluminum
and Aluminum-Alloy Sheet and Plate

ASTM B209M (2014) Standard Specification for Aluminum
and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B221 (2021) Standard Specification for Aluminum
and Aluminum-Alloy Extruded Bars, Rods,
Wire, Profiles, and Tubes

ASTM B221M (2021) Standard Specification for Aluminum
and Aluminum-Alloy Extruded Bars, Rods,
Wire, Profiles, and Tubes (Metric)

ASTM E283 (2019) Standard Test Method for
Determining the Rate of Air Leakage
Through Exterior Windows, Curtain Walls,
and Doors Under Specified Pressure
Differences Across the Specimen

ASTM E331 (2000; R 2016) Standard Test Method for
Water Penetration of Exterior Windows,
Skylights, Doors, and Curtain Walls by
Uniform Static Air Pressure Difference

ASTM E1886 (2019) Standard Test Method for
Performance of Exterior Windows, Curtain
Walls, Doors, and Impact Protective
Systems Impacted by Missile(s) and Exposed

to Cyclic Pressure Differentials

ASTM E1996 (2017) Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100 (2017) Procedure for Determining Fenestration Product U-Factors

NFRC 200 (2017) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Wind Borne Debris

Provide impact resistant door assemblies meeting the Windborne-Debris-Impact Resistant Performance requirements of ASTM E1996 and ASTM E1886 as follows:

- (1) Pass missile-impact tests when tested according to ASTM E1886 and meeting performance requirements according to ASTM E1996 for missiles A and D in Table 2.

1.2.2 Air Infiltration

When tested in accordance with ASTM E283, air infiltration per door leaf cannot exceed 0.6 cubic feet per minute per square foot of fixed area at a test pressure of 6.24 pounds per square foot.

1.2.3 Water Penetration

When tested in accordance with ASTM E331, there can be no water penetration at a pressure of 2.86 pounds per square foot of fixed area.

1.2.4 Thermal Transmittance, Solar Heat Gain, Visible Light Transmittance

Provide products bearing NFRC Project Label Certificates for Fenestration verifying compliance with requirements for each assembly indicated. An NFRC Bid Report, or approved equal, for field assembled exterior doors may be submitted in lieu of Project Label Certificates for Fenestration if such reports are created in accordance with NFRC CAMP procedures and are provided by the manufacturer. Such alternate reports may be submitted with shop drawings, however, NFRC validated Project Label Certificates for Fenestration are required as a Closeout Submittal. Contact NFRC for information on NFRC 100 and NFRC 200 Compliance and Monitoring Program (CAMP) rating requirements:

<http://www.nfrc.org/industry/certification/compliance-and-monitoring-program-camp/>

1.2.4.1 U-Factor

Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area, certified by the NFRC as having a whole window U-factor of 0.7 or less as determined in accordance with

ASHRAE 90.1 - IP and as verified in accordance with NFRC 100.

1.2.4.2 Solar Heat Gain Coefficient (SHGC)

Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area, certified by the National Fenestration Rating Council with a whole window SHGC of 0.38 or less as determined in accordance with ASHRAE 90.1 - IP and as verified in accordance with NFRC 200.

1.2.4.3 Visible Light Transmittance (VLT)

Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area, certified by the NFRC with a whole window VLT of 66 or greater as determined in accordance with ASHRAE 90.1 - IP and as verified in accordance with NFRC 200.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

For Each Type of Door and Frame Assembly; G

SD-03 Product Data

For Each Type of Door and Frame Assembly; G

SD-04 Samples

Finish Samples; G

SD-06 Test Reports

Air Infiltration; G

Water Penetration; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

NFRC Project Label Certificates for Fenestration; G

SD-08 Manufacturer's Instructions

Installation of Each Type of Door and Frame Assembly; G

SD-10 Operation and Maintenance Data

Adjustments, Cleaning, and Maintenance

SD-11 Closeout Submittals

NFRC Project Label Certificates for Fenestration; G

1.3.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements

1.3.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for aluminum doors and aluminum frames.

Provide regional material certifications of applicable materials.

1.3.1.3 IEQ Low Emitting Materials

For doors and frames applied inside the weatherproofing system - submit statement indicating compliance with the;

a. VOC Emissions Evaluation

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on non-absorptive strips or wood platforms. Do not cover doors and frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer's standard method. Do not apply coatings or lacquers to surfaces to which caulking and glazing compounds must adhere.

1.5 QUALITY CONTROL

1.5.1 Shop Drawing

Indicate elevations and sections for each type of door and frame assembly. Show sizes and details of each assembly, frame construction, thickness and gages of metal, details of door and frame construction, proposed method(s) of anchorage, glazing details, provisions for an location of hardware, method and materials for flashing and weatherstripping, miscellaneous trim, installation details, and other related items necessary for a complete representation of all components.

1.5.2 Finish Samples

Submit two color charts and two finish sample chips from manufacturer's standard color and finish options for each type of finish indicated.

1.5.3 Operation and Maintenance Data

Submit detailed instructions for installation, adjustments, cleaning, and maintenance of each type of assembly indicated.

PART 2 PRODUCTS

2.1 DOORS AND FRAMES

Provide swing-type aluminum doors and frames of size, design, and location indicated. Provide doors complete with frames, framing members, transoms, trim, and accessories.

2.2 MATERIALS

2.2.1 Anchors

Stainless steel.

2.2.2 Weatherstripping

Continuous wool pile, silicone treated, or type recommended by door manufacturer.

2.2.3 Aluminum Alloy for Doors and Frames

ASTM B221M, ASTM B221, Alloy 6063-T5 for extrusions. ASTM B209M, ASTM B209, alloy and temper best suited for aluminum sheets and strips. Provide aluminum materials that include a minimum of 30 percent recycled content. Provide data indicating percentage of recycled content of aluminum material.

2.2.4 Fasteners

Hard aluminum or stainless steel.

2.2.5 Structural Steel

ASTM A36/A36M.

2.2.6 Aluminum Paint

Aluminum door manufacturer's standard aluminum paint.

2.3 FABRICATION

2.3.1 Aluminum Frames

Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 12 inches on center. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

2.3.2 Aluminum Doors

Of type, size, and design indicated and minimum 1-3/4 inch thick. minimum wall thickness, 0.125 inch, except beads and trim, 0.050 inch. Door sizes shown are nominal; include standard clearances as follows: 0.093 inch at hinge and lock stiles, 0.125 inch between meeting stiles, 0.125 inch at top rails, 0.187 inch between bottom and threshold, and 0.687 inch between bottom and floor. Provide bevel single-acting doors 0.063 or 0.125 inch at lock, hinge, and meeting stile edges. Provide double-acting doors rounded edges at hinge stile, lock stile, and meeting stile edges.

2.3.2.1 Full Glazed Stile and Rail Doors

Provide doors with medium stiles and rails as indicated. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 3/8 or 1/2 inch diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation.

2.3.2.2 Flush Doors

Use facing sheets with a plain smooth surface. Use one of the following constructions:

- a. A phenolic resin-impregnated kraft paper honeycomb core, surrounded at edges and around glass and louvered areas with extruded aluminum shapes. Provide cores with a minimum impregnation of 18 percent resin content. Provide sheet aluminum door facings minimum 0.032 inch thick laminated to a 0.10 inch thick tempered hardboard backing, with the backing bonded to the honeycomb core. Bond facing sheets to cores under heat and pressure with thermosetting adhesive and mechanically lock to extruded edge members.
- b. A phenolic resin-impregnated kraft paper honeycomb core. Use aluminum facing sheets minimum 0.050 inch thick and form into two pans to eliminate seams on faces. Bond honeycomb core to face sheets using epoxy resin or contact cement-type adhesive.
- c. A solid fibrous core, surrounded at edges and around glass and louvered areas and cross braced at intermediate points with extruded aluminum shapes. Use aluminum facing sheets of minimum 0.050 inch thickness. Bond facing sheets to core under heat and pressure with a thermosetting adhesive, and mechanically lock to the extruded edge members.
- d. Form from extruded tubular stiles and rails mitered at corners, reinforce, and continuously weld at miters. Provide facing sheets of minimum 0.032 inch thick sheet aluminum internally reinforced with aluminum channels or Z-bars placed horizontally not more than 16 inch apart and extending the full width of panels. Fit spaces between reinforcing with sound-deadening insulation. Weld facing sheets to reinforcing bars or channels and to stiles and rails. Finish facing sheets flush with faces of stiles and rails.
- e. Form from an internal grid composed of extruded aluminum tubular sections. Provide tubular sections at all sides and perimeter of louver and glass openings. Provide three extruded aluminum tubular

sections at top and bottom of each door. Provide wall thickness of tubular sections minimum 0.09 inch except at lock rails which must be minimum 0.125 inch thick, hinge lock rails which must be minimum 0.125 inch thick, and hinge rail edges which must be minimum 0.19 inch thick. Fill spaces in door with mineral insulation. Provide facing sheets of aluminum minimum 0.09 inch thick.

- f. Form from extruded aluminum members at top and bottom, both sides, and at perimeters of louver and glass openings. Provide wall sections of extruded aluminum members minimum 0.09 inch thick and reinforce for application of hardware. Cover framing members on both sides with aluminum facing sheets minimum 0.064 inch thick. Fill door panels with 2.5 pound per cubic foot density, chlorofluorocarbon (CFC) free, foamed urethane with a flame spread rating of no more than 25.

2.3.3 Welding and Fastening

Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and must have countersunk heads. Weld concealed reinforcements for hardware in place.

2.3.4 Weatherstripping

Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weatherstripping must be replaceable without special tools, and adjustable at meeting rails of pairs of doors. During installation, verify doors swing freely and close positively. Refer to paragraph AIR INFILTRATION for air leakage requirements and testing.

2.3.5 Anchors

Anchor transom bars at ends and mullions at head and sill. Reinforce and anchor freestanding door frames to floor construction as indicated on approved shop drawings and in accordance with manufacturer's recommendation. Place anchors near top and bottom of each jamb and at intermediate points not more than 25 inch apart.

2.3.6 Provisions for Hardware

Coordinate with Section 08 71 00 DOOR HARDWARE. Deliver hardware templates and hardware (except field-applied hardware) to the door manufacturer for use in fabrication of aluminum doors and frames. Cut, reinforce, drill, and tap doors and frames at the factory to receive template hardware. Provide doors to receive surface-applied hardware, except push plates, kick plates, and mop plates, with reinforcing only; drill and tap in the field. Provide hardware reinforcements of stainless steel or steel with hot-dipped galvanized finish, and secure with stainless steel screws. Provide reinforcement in core of flush doors as required to receive locks, door closers, and other hardware.

2.3.7 Provisions for Glazing

Provide extruded aluminum snap-in glazing beads on interior side of doors. Provide glazing beads with vinyl insert glazing gaskets. Design glazing beads to receive thickness indicated for each glazed assembly. Coordinate

requirements with Section 08 81 00 GLAZING.

2.3.8 Finishes

Provide exposed aluminum surfaces with factory finish of anodic coating or organic coating.

2.3.8.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF45. Provide integral color-anodized, designation AA-M10-C22-A32, Architectural Class II 0.4 mil to 0.7 mil finish for interior storefront doors and integral color-anodized, designation AA-M10-C22-A42, Architectural Class I 0.7 mil or thicker finish for exterior storefront doors. Provide material(s) in color(s) as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Plumb, square, level, and align frames and framing members to receive doors, transoms. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions and the approved shop drawings. Install anchorage that complies with applicable structural requirements. Anchor bottom of each frame to rough floor construction with 3/32 inch thick minimum stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Hang doors to produce clearances specified in paragraph ALUMINUM DOORS. After erection and glazing, adjust doors and hardware to operate properly.

3.2 PROTECTION FROM DISSIMILAR MATERIALS

3.2.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact to dissimilar metals.

3.2.1.1 Protection

Provide one of the following systems to protect surfaces in contact with dissimilar metals:

- a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.
- b. Apply elastomeric sealant between aluminum and dissimilar metals in accordance with Section 07 92 00 JOINT SEALANTS.
- c. Paint dissimilar metals with one coat of primer and one coat of aluminum paint.
- d. Use a non-absorptive tape or gasket in permanently dry locations.

3.2.2 Drainage from Dissimilar Metals

In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint to prevent aluminum discoloration.

3.2.3 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.2.4 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting aluminum, paint the wood or other absorptive surface with two coats of aluminum paint and seal joints with elastomeric sealant.

3.3 SEALING AROUND ASSEMBLIES

Seal all penetrations of the air barrier by sealing around door openings as necessary to achieve compliance with air leakage requirements indicated in the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, and Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS. Flash all doors with corrosion resistant flashing to prevent water intrusion.

3.4 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's written recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.

3.5 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

-- End of Section --

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SECTION 08 14 00

WOOD DOORS

08/16, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E90 (2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

ASTM E2226 (2015; R 2019b) Standard Practice for Application of Hose Stream

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (2019) Standard for Fire Doors and Other Opening Protectives

NFPA 252 (2017) Standard Methods of Fire Tests of Door Assemblies

UNDERWRITERS LABORATORIES (UL)

UL 10B (2008; Reprint May 2020) Fire Tests of Door Assemblies

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

ANSI/WDMA I.S.1A (2013) Interior Architectural Wood Flush Doors

ANSI/WDMA I.S.6A (2013) Interior Architectural Stile and Rail Doors

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G

Submit drawings or catalog data showing each type of door unit . Indicate within drawings and data the door types and construction,

sizes, thickness, methods of assembly, and glazing,.

SD-03 Product Data

Doors; G

Accessories

Water-resistant Sealer

Sample Warranty

Sound Transmission Class Rating; G

Fire Resistance Rating; G

SD-04 Samples

Door Finish Color; G

Submit a minimum of three color selection samples , minimum 3 by 5 inches in size representing wood stain Contracting Officer.

SD-06 Test Reports

Cycle-Slam

Hinge Loading Resistance

Submit cycle-slam test report for doors tested in accordance with ANSI/WDMA I.S.1A, and hinge loading resistance test report for doors tested in accordance with ANSI/WDMA I.S.6A.

SD-07 Certificates

Certificates of Grade

EPD(s); S

Recycled Content; S

Regional Material; S

Certified Sustainably Harvested Flush Wood Doors; S

Including certification for FSC and Legal Wood LEED credits are required.

Indoor Air Quality for Particleboard and Agrifiber Door Cores: S

Including certification for VOC Emissions and Formaldehyde Emissions as required.

SD-11 Closeout Submittals

Warranty

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of door cores.

Provide regional material certifications for all materials that apply.

Provide Forest Stewardship Council (FSC) Certification for wood products.

1.2.1.3 IEQ Low Emitting Materials

For doors applied inside the weatherproofing system - submit statement indicating compliance with the;

a. VOC Emissions Evaluation

For Composite Wood applied inside the weatherproofing system - submit statement indicating compliance with the;

a. Formaldehyde Emissions Evaluation

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

1.2.1.4 Pilot Credit Legal Wood

Submit product data verifying product is from Legal and Responsible Sources per ASTM D7612-10 as required to achieve LEED credit.

1.3 CERTIFICATIONS

1.3.1 Certified Wood Grades

Provide certificates of grade from the grading agency on fire doors.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 4 inch thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and plaster are dry. Replace defective or damaged doors with new ones.

1.5 WARRANTY

Warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

PART 2 PRODUCTS

2.1 DOORS

Provide doors of the types, sizes, and designs indicated free of urea-formaldehyde resins.

2.1.1 Flush Doors

Conform to ANSI/WDMA I.S.1A for flush doors. Provide hollow core doors with lock blocks and 1 inch minimum thickness hinge stile. Hardwood stile edge bands of doors receives a natural finish, compatible with face veneer. Provide mill option for stile edge of doors scheduled to be painted. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware. Provide certified sustainably harvested flush wood doors.

2.1.1.1 Interior Flush Doors

Provide particleboard or agrifiber core, Type II flush doors conforming to ANSI/WDMA I.S.1A with faces of premium grade white oak. Hardwood veneers must be plain sliced book matched. Door cores must have a minimum recycled content of 45 percent. Provide data identifying percentage of recycled content for door cores. Products must contain no added urea-formaldehyde resins. Provide certification of indoor air quality for particleboard and agrifiber door cores.

2.1.2 Acoustical Doors

ANSI/WDMA I.S.1A, solid core, constructed to provide Sound Transmission Class rating of 35 when tested in accordance with ASTM E90.

2.1.3 Fire Doors

Provide doors specified or indicated to have a fire resistance rating conforming to the requirements of UL 10B, ASTM E2226, or NFPA 252 for the class of door indicated. Affix a permanent metal label with raised or incised markings indicating testing agency's name and approved hourly fire rating to hinge edge of each door.

2.2 ACCESSORIES

2.2.1 Door Light Openings

Provide glazed openings with the manufacturer's standard wood moldings. Provide moldings for doors to receive natural finish of the same wood species and color as the wood face veneers. Lip type moldings for flush doors.

2.2.2 Additional Hardware Reinforcement

Provide the minimum lock blocks to secure the specified hardware. The measurement of top, bottom, and intermediate rail blocks are a minimum 125 mm 5 inch by full core width. Comply with the manufacturer's labeling requirements for reinforcement blocking, but not mineral material similar to the core.

2.3 FABRICATION

2.3.1 Marking

Stamp each door with a brand, stamp, or other identifying mark indicating quality and construction of the door.

2.3.2 Quality and Construction

Identify the standard on which the construction of the door was based, identify the standard under which preservative treatment was made, and identify doors having a Type I glue bond.

2.3.3 Preservative Treatment

Treat doors scheduled for restrooms, janitor closets and other possible wet locations with a water-repellent preservative treatment and so marketed at the manufacturer's plant.

2.3.4 Adhesives and Bonds

ANSI/WDMA I.S.1A. Use Type I bond for exterior doors and Type II bond for interior doors. Provide a nonstaining adhesive on doors with a natural finish.

2.3.5 Prefitting

Provide factoryfactory prefitted doors for the specified hardware, door frame and door-swing indicated. Machine and size doors at the factory by the door manufacturer in accordance with the standards under which the doors are produced and manufactured. The work includes sizing, beveling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules to coordinate the work.

2.3.6 Finishes

2.3.6.1 Field Painting

Factory prime or seal doors, and field paint.

2.3.6.2 Color

Provide door finish color in accordance with Finish Schedule on drawings.

2.3.7 Water-Resistant Sealer

Provide manufacturer's standard water-resistant sealer compatible with the specified finish.

2.4 SOURCE QUALITY CONTROL

Meet or exceed the following minimum performance criteria of stiles of "C" label fire doors utilizing standard mortise leaf hinges:

- a. Cycle-slam: Heavy Duty Doors: 500,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of ANSI/WDMA I.S.1A.

- b. Hinge loading resistance: Averages of ten test samples not less than Heavy Duty doors: 475 pounds force when tested for direct screw withdrawal in accordance with ANSI/WDMA I.S.6A using a No. 12, 1-1/4 inch long, steel, fully threaded wood screw. Drill 5/32 inch pilot hole, use 1-1/2 inch opening around screw for bearing surface, and engage screw full, except for last 1/8 inch. Do not use a steel plate to reinforce screw area.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 1/16 inch minimum, 1/8 inch maximum clearance at sides and top, and a 3/16 inch minimum, 1/4 inch maximum clearance over thresholds. Provide 3/8 inch minimum, 7/16 inch maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 1/8 inch in 2 inch. Door warp must not exceed 1/4 inch when measured in accordance with ANSI/WDMA I.S.1A.

3.1.1 Fire Doors

Install fire doors in accordance with NFPA 80. Do not paint over labels.

-- End of Section --

SECTION 08 31 00

ACCESS DOORS AND PANELS

05/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding
Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon
Structural Steel

ASTM A653/A653M (2020) Standard Specification for Steel
Sheet, Zinc-Coated (Galvanized) or
Zinc-Iron Alloy-Coated (Galvannealed) by
the Hot-Dip Process

ASTM A666 (2015) Standard Specification for Annealed
or Cold-Worked Austenitic Stainless Steel
Sheet, Strip, Plate and Flat Bar

ASTM A1008/A1008M (2021a) Standard Specification for Steel,
Sheet, Cold-Rolled, Carbon, Structural,
High-Strength Low-Alloy, High-Strength
Low-Alloy with Improved Formability,
Solution Hardened, and Bake Hardenable

MASTER PAINTERS INSTITUTE (MPI)

MPI 79 (2016) Primer, Alkyd, Anti-Corrosive for
Metal

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (2019) Standard for Fire Doors and Other
Opening Protectives

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Access Doors And Panels; G

SD-03 Product Data

Access Doors And Panels; G

Hardware Including Locks and Keys; G

Accessories; G

SD-04 Samples

Finishes; G

SD-07 Certificates

Recycled Content; S

Regional Material; S

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Sourcing of Raw Materials

Provide recycled content certifications for access door/panel materials.

Provide regional material certifications of applicable materials.

1.4 MISCELLANEOUS REQUIREMENTS

For access doors and panels provide the following:

1.4.1 Shop Drawings

For field assembled access doors and panels, provide plans, elevations, sections, and details for each type of access door and panel assembly. Indicate frame, surface and edge construction, materials, and accessories. Indicate types of finished surfaces and details for panel edge conditions. Provide a door schedule with a unique number for each access door and panel, specific location in the project, location of hinges and hardware for each door.

1.4.2 Product Data

For shop assembled access doors and panels, provide literature indicating sizes, types, frame and edge construction, finishes, hardware, accessories such as gaskets, seals and weatherstripping, and location of each door and panel in the project. Provide details of adjoining work for each condition indicated.

1.4.3 Finish Samples

Submit two color charts from manufacturer's standard color and finish options for each type of frame and panel assembly finish indicated.

1.5 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content. Provide data for each product with recycled content, identifying percentage of recycled content.

2.2 MATERIALS

2.2.1 Steel Plates, Shapes, and Bars

Provide in accordance with ASTM A36/A36M.

2.2.2 Sheet Steel

Provide cold rolled steel sheet substrate in accordance with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

2.2.3 Stainless Steel

Provide in accordance with ASTM A666, type 302 or 304.

2.2.4 Metallic Coated Steel Sheet

Provide in accordance with ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.2.5 Hardware

Provide automatic closing devices. Provide latch releases operable from insides of doors.

2.2.6 Hinges

Provide concealed spring hinges, 175 degrees of opening, with removable hinge pins to allow removal of door panel from frame. Provide hinges of same steel as door and frame or in accordance with manufacturer's written recommendations. If providing non-continuous hinges, provide in numbers required to maintain alignment of door panel with frame. Provide coatings as necessary to permanently protect dissimilar metals from contact with one another; see Part 3 herein for more information.

2.2.7 Locks

Unless otherwise indicated, provide flush screwdriver operated cam lock. Provide plastic sleeve or stainless steel bushings to protect holes in surface finishes for screwdriver to access lock. Lock cylinders are specified in Section 08 71 00 DOOR HARDWARE.

2.2.8 Accessories

Provide anchors in size, number and location on four sides to secure access door to substrate. Provide anchors in types as recommended by

manufacturer's written installation instructions for each substrate indicated. Provide shims, bushings, clips, gaskets, and other devices as necessary for a complete installation.

2.3 FABRICATION

2.3.1 Thickness, Size, Edges

Fabricate frames for access doors of steel not lighter than 16 gage with welded joints and anchorage for securing to adjacent construction. Provide doors a minimum of 24 by 24 inches and of not lighter than 16 gage steel, with stiffened edges and welded attachments. Provide with eased (lightly rounded) edges, without burrs, snags or sharpness and exposed welds ground smooth.

2.3.2 Welding

Provide in accordance with AWS D1.1/D1.1M.

2.4 ACCESS ASSEMBLY TYPES

Unless indicated otherwise, provide flush-face steel access doors and panels with steel frames and flanges.

2.4.1 Recessed Doors

Provide recessed access doors with gypsum wallboard bead flanges. Depth of door panel recess must accommodate the installed thickness of the finish material of the wall assembly for a flush finished condition of the wall and the access panel face. Reinforce panel and frame to prevent sagging.

2.5 FINISHES

Provide steel frame and panel surfaces with a shop applied prime coat. Field paint frames and panels to match wall and ceiling surfaces in which they occur. Provide exposed fastenings that approximately match the color and finish of the each material to which fastenings are applied.

PART 3 EXECUTION

3.1 PREPARATION

Field verify all measurements prior to fabrication. Verify access door locations and sizes provide required maintenance access to installed building services components. Protect existing construction and completed work from damage during installation.

3.2 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, in accordance with manufacturer's written instructions. Include materials and parts as necessary for a complete installation of each item. Conceal fastenings where practicable. Poor matching of holes to fasteners is cause for rejection of the work.

3.3 ACCESS LOCATIONS

Install removable access panels directly below each valve, flow indicator,

damper, air splitter or other utility requiring access that is located above ceilings, other than at acoustical panel ceilings, and that would otherwise not be accessible. Install access doors and panels permitting access to service valves, traps, dampers, cleanouts, and other mechanical, electrical and conveyor control items concealed in walls and partitions.

3.4 ACCESS LOCATIONS IN WET AREAS

When possible, avoid locating access panels in wet areas. When such locations cannot be avoided, provide moisture resistant assemblies as indicated in Part I herein.

3.5 RECESSED ACCESS DOORS

Install fire-rated access doors in fire-rated partitions and ceilings in accordance with NFPA 80.

3.6 FIELD PAINTING

Field painting primed access doors in accordance with the requirements of Section 09 90 00 PAINTS AND COATINGS.

3.7 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, protect surfaces with a coating in accordance with MPI 79 to prevent galvanic or corrosive action.

3.8 ADJUSTMENT

Adjust hardware so that door panel opens freely. Adjust door when closed center door panel in frame.

3.9 ENVIRONMENTAL CONDITIONS

Do not paint surfaces when damp or exposed to weather, when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

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SECTION 08 32 13

SLIDING GLASS DOORS

08/20

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Sliding Glass Doors (including associated glazing fixed partitions)

SD-03 Product Data

Hardware

Glazing

SD-04 Samples

Glazing with Scheduled Window Film

Hardware - Including Pull and Track

SD-07 Certificates

EPD; S

Recycled Content; S

Regional Material; S

VOC Emissions; S

1.1.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.1.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.1.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of glass and framing materials.

Provide regional material certifications of applicable materials.

1.1.1.3 IEQ Low-Emitting Materials

For glass doors applied inside the weatherproofing system - submit VOC statement indicating compliance with the;

a. VOC Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.1.2 Shop Drawing Information

Submit drawings for sliding glass door system complete. Include elevations and sections of each door type. Indicate glazing types/thicknesses and gages of metal, finishes and details of operating hardware. Show proposed method of installation/anchoring and fasteners.

1.1.3 Samples Information

Submit 2 x 2 inch minimum metal color samples of pull and track available metal finishes. Submit min 12 x 12 inch minimum glass sample with scheduled window film.

PART 2 PRODUCTS

2.1 SLIDING GLASS DOORS

Provide top hung sliding glass doors system with sliding panels and fixed panels in the sizes and arrangements indicated. Sliding door glazing must be set in aluminum frames and roller assemblies of sufficient strength to withstand lateral live stresses and static load or weight requirements.

2.1.1 Hardware

Refer to 08 71 00 Door Hardware specification section for glass door hardware set, including Aluminum Top Hung Sliding Door System and Door Pull. Submit with this specification section.

2.1.2 Glazing

Refer to 08 81 00 Glazing specification section for glass door glazing. Mark panels identically and permanently to visibly interrupt the span of glass. Use markings of the design indicated. Sample must include permanent window film.

2.2 CAULKING AND SEALING

As specified under Section 07 92 00 JOINT SEALANTS.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Doors, Frames, and Accessories

Install doors, frames, framing members, hardware, and accessories in accordance with approved shop drawings and the requirements specified herein. Set frames securely anchored in place to straight, plumb, square, level condition without distortion and in alignment. Caulk metal-to-metal

joints between frame members and remove excess material. Finished work must be rigid, neat in appearance, and free from defects. Upon completion, adjust sliding doors to operate properly. Thoroughly clean aluminum frames and glass in accordance with manufacturer's recommendation. Doors damaged prior to completion and acceptance must be restored to original manufactured condition or replaced with new doors as directed.

3.1.2 Protection of Aluminum from Dissimilar Materials

3.1.2.1 Aluminum to Dissimilar Metals

Prevent aluminum surfaces from contacting dissimilar metals other than stainless steel, zinc, or white bronze by one or a combination of the following:

- a. Paint dissimilar metal with one coat of heavy-bodied bituminous paint.
- b. Apply caulking between aluminum and dissimilar metal.
- c. Paint dissimilar metal with primer, followed by one coat of aluminum paint or other suitable lead-free coating.
- d. Use nonabsorptive tape or gasket in permanently dry locations.

3.1.2.2 Aluminum to Masonry and Concrete

Prevent aluminum surfaces from coming into contact with mortar, concrete, or other masonry materials by applying one coat of heavy-bodied bituminous paint to the aluminum surfaces.

3.1.2.3 Aluminum to Wood

Prevent aluminum surfaces from coming into contact with wood, treated wood, or similarly absorptive materials by one or a combination of the following methods:

- a. Paint aluminum surfaces with two coats of aluminum paint or one coat of heavy-bodied bituminous paint.
- b. Paint the wood, treated wood, or other absorptive surfaces with two coats of aluminum paint and seal contiguous joints with caulking compound.

-- End of Section --

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SECTION 08 33 23

OVERHEAD COILING DOORS
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2605 (2020) Voluntary Specification,
Performance Requirements and Test
Procedures for Superior Performing Organic
Coatings on Aluminum Extrusions and Panels

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16 (2017; Errata 2018; Supp 1 2018) Minimum
Design Loads and Associated Criteria for
Buildings and Other Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE FUN IP (2017) Fundamentals Handbook, I-P Edition

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B29.400 (2001; (R 2008) (R 2013) (R 2018))
Combination, "H" Type Mill Chains, and
Sprockets

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon
Structural Steel

ASTM A47/A47M (1999; R 2018; E 2018) Standard
Specification for Ferritic Malleable Iron
Castings

ASTM A53/A53M (2020) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

ASTM A153/A153M (2016a) Standard Specification for Zinc
Coating (Hot-Dip) on Iron and Steel
Hardware

ASTM A307 (2021) Standard Specification for Carbon
Steel Bolts, Studs, and Threaded Rod 60
000 PSI Tensile Strength

ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A666	(2015) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E330/E330M	(2014) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM F568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

DOOR AND ACCESS SYSTEM MANUFACTURERS ASSOCIATION (DASMA)

ANSI/DASMA 108	(2017) Standard Method for Testing Sectional Garage Doors, Rolling Doors and Flexible Doors: Determination of Structural Performance Under Uniform Static Air Pressure Difference
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA MG 1	(2018) Motors and Generators

NEMA ST 1 (1988; R 1994; R 1997) Specialty
Transformers (Except General Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 325 (2017; Reprint Feb 2020) UL Standard for
Safety Door, Drapery, Gate, Louver, and
Window Operators and Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Overhead Coiling Doors; G
Counterbalancing Mechanism; G
Electric Door Operators; G
Bottom Bars; G
Guides; G
Mounting Brackets; G
Hood; G
Installation Drawings

SD-03 Product Data

Overhead Coiling Doors; G
Hardware; G
Counterbalancing Mechanism; G
Electric Door Operators; G

SD-05 Design Data

Overhead Coiling Doors; G
Hardware; G
Counterbalancing Mechanism; G
Electric Door Operators; G

SD-07 Certificates

EPD(s); S

VOC Emissions; S

Recycled Content; S

Regional Material; S

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, Data Package 2; G

SD-11 Closeout Submittals

Warranty

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements

1.3.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for doors.

Provide regional material certifications of applicable materials.

1.3.3 IEQ Low Emitting Materials

For overhead doors - submit statement indicating compliance with the;

a. VOC Emissions Evaluation

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

1.4 QUALITY CONTROL

1.4.1 Warranty

Furnish a written guarantee that the helical spring and counterbalance mechanism are free from defects in material and workmanship for not less than two years after completion and acceptance of the project.

Warrant that upon notification by the Government, any defects in material, workmanship, and door operation are immediately correct within the same time period covered by the guarantee, at no cost to the Government.

1.4.2 Operation And Maintenance Submittals

Submit 6 copies of the operation and maintenance manuals 30 calendar days

prior to testing the Overhead Coiling Door Assemblies. Update and resubmit data for final approval no later than 30 calendar days prior to cContract completion.

Submit Operation and Maintenance Manuals for Overhead Coiling Door Assemblies, including the following items:

Electric Door Operators

Hood

Counterbalancing Mechanism

Painting

Provide operation and maintenance manuals which are consistent with manufacturer's standard brochures, schematics, printed instructions, operating procedures, and safety precautions.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Store doors in an adequately ventilated dry location that is free from dirt and dust, water, or other contaminants. Store in a manner that permits easy access for inspection and handling. Handle doors carefully to prevent damage. Remove damaged items that cannot be restored to like-new condition and provide new items.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide overhead coiling doors with interlocking slats, complete with anchoring and door hardware, guides, hood, and operating mechanisms, and designed for use on openings as indicated. Doors must be spring counterbalanced, rolling type, and designed for use on exterior openings, as indicated. Doors must be operated by electric-power with auxiliary hand chain operation. Doors to be surface-mounted type with guides at jambs set back a sufficient distance to provide a clear opening when door is in open position. Mount exterior doors on interior face of walls.

2.1.1 Design Requirements

2.1.1.1 Door Detail Shop Drawings

Provide installation drawings for door assemblies which show: elevations of each door type, shape and thickness of materials, finishes, details of joints and connections, details of guides and fittings, rough opening dimensions, location and description of hardware, anchorage locations, and counterbalancing mechanism and door operator details. Show locations of replaceable fusible links on wiring diagrams for power, signal and controls. For motor-operated doors include supporting brackets for motors, location, type, and ratings of motors, and safety devices. Include a schedule showing the location of each door with the drawings.

2.1.2 Performance Requirements

2.1.2.1 Wind Loading

Design and fabricate door assembly to withstand the wind loading pressure as indicated in structural drawings for the Admin/Warehouse Building and per the Metal Building System manufacturer for the Boat Repair Building in accordance with ANSI/DASMA 108. Provide test data showing compliance with ASTM E330/E330M. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested. Ensure that the complete assembly meets or exceeds the requirements of ASCE 7-16.

2.1.2.2 Operational Cycle Life

Design all portions of the door, hardware and operating mechanism that are subject to movement, wear, or stress fatigue to operate through a minimum number of 20 cycles per day. Door and operator system to have a high usage warranty for 100,000 openings. One complete cycle of door operation is defined as when the door is in the closed position, moves to the fully open position, and returns to the closed position.

2.2 COMPONENTS

2.2.1 Overhead Coiling Doors

2.2.1.1 Curtain Materials and Construction

Provide curtain slats fabricated from aluminum sheets conforming to ASTM B209, or ASTM B221 extrusions, alloy and tempering standard from the manufacturer for type of use and finish indicated; with a thickness as required by the size of the door to meet the required windload.

Fabricate doors from interlocking cold-rolled slats, with section profiles as specified, designed to withstand the specified wind loading. Ensure the provided slats are continuous without splices for the width of the door.

Provide slats filled with manufacturer's standard thermal insulation, complying with the maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose the insulation completely within the slat faces on the interior surface of the slats.

2.2.1.2 Insulated Curtains

Form curtains from manufacturer's standard shapes of interlocking slats. Supply a slat system with a minimum R-value of 7.5 when calculated in accordance with ASHRAE FUN IP. Slats to consist of a urethane or polystyrene core not less than 11/16 inch thick, completely enclosed within metal facings. Slat steel thickness as required by the size of the door to meet specified performance requirements. The insulated slat assembly requires a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E84.

2.2.1.3 Curtain Bottom Bar

Install curtain bottom bars as pairs of angles or using extrusions from the manufacturer's standard steel, stainless and aluminum extrusions not less than 2.0 by 2.0 inches by 0.188 inch. Do not use aluminum on doors

more than 16 feet wide. Ensure steel extrusions conform to ASTM A36/A36M. Stainless steel extrusions conforming to ASTM A666, Type 304. Aluminum extrusions conforming to ASTM B221. Galvanize angles and fasteners in accordance with ASTM A653/A653M and ASTM A924/A924M. Coat welds and abrasions with paint conforming to ASTM A780/A780M.

Provide two minimum 2 inch by 2 inch by 1/8 inch structural steel angles.

2.2.1.4 Endlocks (and Windlocks)

Provide endlocks of Grade B cast steel conforming to ASTM A47/A47M, galvanized in accordance with ASTM A153/A153M. Secure locks at every other curtain slat. In addition to endlocks, exterior doors which are more than 16 feet wide or which have a design wind load of more than 20 pounds per square foot, must have windlocks of manufacturer's standard design. Windlocks must prevent curtain from leaving guide because of deflection from wind pressure or other forces.

2.2.1.5 Weather Stripping

Provide a hood baffle inside the hood that is a minimum 1/16 inch thick sheet of vinyl, neoprene rubber or equivalent. Provide guide weather stripping that is a minimum 1/16 inch thick sheet of vinyl, neoprene rubber, or equivalent.

Provide bottom bar weather-stripping that is a minimum 1/16 inch thick sheet of vinyl, neoprene rubber, or equivalent.

2.2.1.6 Locking Devices

Ensure that the slide bolt engages through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

Provide a locking device assembly which includes cylinder lock, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

Provide a chain lock keeper suitable for a standard padlock.

2.2.1.7 Safety Interlock

Equip power-operated doors with a safety interlock switch to disengage power supply when the door is locked, or provide an operator with an internal lock sensing device to prevent the door opening when the door is locked.

2.2.2 Hardware

Ensure that all hardware conforms to ASTM A153/A153M, ASTM A307, and ASTM F568M.

2.2.2.1 Guides

Fabricate curtain jamb guides from the manufacturer's standard angles or channels of same material and finish as curtain slats unless otherwise indicated. Provide guides with sufficient depth or incorporate a steel locking bar to retain the curtain in place under the wind pressure specified. Ensure curtain operates smoothly. Slot bolt holes for track

adjustment. Securely attach guides to adjoining construction with not less than 3/8 inch diameter bolts, spaced near each end and not over 30 inches apart.

Fabricate with structural steel angles. Provide windlock bars of same material when windlocks are required to meet specified wind load. Flare the top of inner and outer guide angles outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.

2.2.2.2 Hood

Provide a hood with a minimum aluminum 18-gauge B&S sheet metal, flanged at top for attachment to header and flanged at bottom to provide longitudinal stiffness. The hood encloses the curtain coil and counterbalance mechanism.

Hoods for openings more than 12 feet in width must have intermediate support brackets to prevent excessive sag. Provide a weather baffle at the lintel or inside the hood of each exterior door.

2.2.3 Counterbalancing Mechanism

Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted, around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members.

2.2.3.1 Brackets

Provide the manufacturer's standard mounting brackets with one located at each end of the counterbalance barrel conforming to ASTM A36/A36M. Provide brackets of hot-rolled steel.

Brackets will be of 1/4 inch minimum thick steel plates, with permanently sealed ball bearings. Designed to enclose ends of coil and provide support of counterbalance pipe at each end.

2.2.3.2 Counterbalance Barrels

Curtain must roll up on a barrel supported at head of opening on brackets and be balanced by a torsion spring system in the barrel. Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, conforming to ASTM A53/A53M or equivalent. Ensure the barrel is of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats. Limit barrel deflection to not more than 0.03 inch per foot of span under full load.

a. Barrel

Provide steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.

b. Spring Balance

Provide an oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door. Ensure that effort to

operate manually operated units does not exceed 25 lbs. At least 80 percent of the door weight must be counterbalanced at any position. Provide wheel for applying and adjusting spring torque.

2.2.3.3 Torsion Rod for Counter Balance

Fabricate rod from the manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

2.2.4 Electric Door Operators

Provide electrical wiring and door operating controls conforming to the applicable requirements of NFPA 70 and UL 325. The door manufacturer must furnish automatic control and safety devices, including extra flexible type SO cable and spring-loaded automatic takeup reel or equivalent device, as required for proper operation of the doors. Conduit, wiring, and mounting of controls are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

Electric door-operator assemblies need to be the sizes and capacities recommended and provided by the door manufacturer for specified doors. Furnish complete assemblies with electric motors and factory-prewired motor controls, starter, gear reduction units, solenoid-operated brakes, clutch, remote-control stations, manual or automatic control devices, and accessories as required for proper operation of the doors.

Design the operators so that motors may be removed without disturbing the limit-switch adjustment and affecting the emergency auxiliary operators.

Provide a manual operator of crank-gear or chain-gear mechanisms with a release clutch to permit manual operation of doors in case of power failure. Arrange the emergency manual operator so that it may be put into and out of operation from floor level, and its use does not affect the adjustment of the limit switches. Provide an electrical or mechanical device that automatically disconnects the motor from the operating mechanism when the emergency manual operating mechanism is engaged.

2.2.4.1 Door-Operator Types

Provide an operator mounted to the inside front wall on the right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.

2.2.4.2 Electric Motors

Provide motors which are the high-starting-torque, reversible, constant-duty electrical type with overload protection of sufficient torque and horsepower to move the door in either direction from any position. Ensure they produce a door-travel speed of not less than 8 nor more than 12 inches per second without exceeding the horsepower rating.

Provide motors which conform to NEMA MG 1 designation, temperature rating, service factor, enclosure type, and efficiency to the requirements specified. Motors must be suitable for operation on current of the characteristics indicated. Single-phase motors must not have commutation or more than one starting contact. Install motors in approved locations.

2.2.4.3 Motor Bearings

Select bearings with bronze-sleeve or heavy-duty ball or roller antifriction type with full provisions for the type of thrust imposed by the specific duty load.

Pre-lubricate and factory seal bearings in motors less than 1/2 horsepower.

Equip motors coupled to worm-gear reduction units with either ball or roller bearings.

Equip bearings in motors 1/2 horsepower or larger with lubrication service fittings. Fit lubrication fittings with color-coded plastic or metal dust caps.

In any motor, bearings that are lubricated at the factory for extended duty periods do not need to be lubricated for a given number of operating hours. Display this information on an appropriate tag or label on the motor with instructions for lubrication cycle maintenance.

2.2.4.4 Motor Starters, Controls, and Enclosures

Provide each door motor with: a factory-wired, unfused, disconnect switch; a reversing, across-the-line magnetic starter with thermal overload protection; 120-volt operating coils with a control transformer limit switch; and a safety interlock assembled in a NEMA ICS 6 type enclosure as specified herein. Ensure control equipment conforms to NEMA ICS 1 and NEMA ICS 2.

Provide adjustable switches, electrically interlocked with the motor controls and set to stop the door automatically at the fully open and fully closed position.

2.2.4.5 Control Enclosures

Provide control enclosures that conform to NEMA ICS 6 for general purpose NEMA Type 1.

2.2.4.6 Transformer

Provide starters with 230/460 to 115 volt control transformers with one secondary fuse when required to reduce the voltage on control circuits to 120 volts or less. Provide a transformer conforming to NEMA ST 1.

2.2.4.7 Sensing-Edge Device

Provide each door with a pneumatic or electric sensing device that meets UL 325, extends the full width of the door, and is located within a U-section neoprene or rubber astragal, mounted on the bottom rail of the bottom door section. Device needs to immediately stop and reverse the door upon contact with an obstruction in the door opening or upon failure of the device or any component of the control system and cause the door to return to its user-defined open position. Any momentary door-closing circuit must be automatically locked out and the door must be operable manually or with constant pressure controls until the failure or damage has been corrected. A sensing device is not a substitute for a limit switch.

Connect sensing device to the control circuit through a retracting cord

and reel.

2.2.4.8 Remote-Control Stations

Remote control stations must be at least 5 feet above the floor line, and all switches must be located so that the operator will have complete visibility of the door at all times. Provide interior remote control stations that are full-guarded, momentary-contact three-button, heavy-duty, surface-mounted NEMA ICS 6 type enclosures as specified. Mark buttons "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" buttons must be of the type requiring only momentary pressure to operate. The "CLOSE" button must be of the type either requiring constant pressure to maintain the closing motion of the door or momentary pressure when installed with a monitored entrapment detection device which, upon failure of the device or any component of the control system, cause the door to return to its full open position. When the door is in motion and the "STOP" button is pressed, ensure the door stops instantly and remains in the stopped position. From the stopped position, the door may then be operated in either direction by the "OPEN" or "CLOSE" buttons. When the door is in motion, and the "CLOSE" button of the constant pressure type is released, the door must stop and remain in the stop position or reverse to the user set up position; from the stop position, the door may then be operated in either direction by the "OPEN" or "CLOSE" buttons. Controls must be adjustable to automatically stop the doors at their fully open and closed positions. Open and closed positions must be readily adjustable.

2.2.4.9 Speed-Reduction Units

Provide speed-reduction units consisting of hardened-steel worm and bronze worm gear assemblies or planetary gear reducers running in oil or grease and inside a sealed casing, coupled to the motor through a flexible coupling. Drive shafts need to rotate on ball- or roller-bearing assemblies that are integral with the unit.

Provide minimum ratings of speed reduction units in accordance with AGMA provisions for class of service.

Ground worm gears to provide accurate thread form; machine teeth for all other types of gearing. Surface harden all gears.

Provide antifriction type bearings equipped with oil seals.

2.2.4.10 Chain Drives

Provide roller chains that are a power-transmission series steel roller type conforming to ASME B29.400, with a minimum safety factor of 10 times the design load.

Heat-treat or otherwise harden roller-chain side bars, rollers, pins, and bushings.

Provide high-carbon steel chain sprockets with machine-cut hardened teeth, finished bore and keyseat, and hollow-head setscrews.

2.2.4.11 Brakes

Provide 360-degree shoe brakes or shoe and drum brakes. Ensure the brakes are solenoid-operated and electrically interlocked to the control circuit to set automatically when power is interrupted.

2.2.4.12 Clutches

Ensure clutches are friction type or adjustable centrifugal type.

2.2.4.13 Weather/Smoke Seal Sensing Edge

Provide automatic stop control by an automatic sensing switch within neoprene astragal extending the full width of door bottom bar.

Provide an electric sensing edge device. Ensure the door immediately stops downward travel when contact occurs before door fully closes. Provide a self-monitoring sensing edge connection to the motor operator.

2.2.5 Surface Finishing

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Noticeable variations in the same metal component are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

2.2.5.1 Powder-Coat Finish

Door finish to be Kynar 500/Hylar 5000 with a 70 percent PVDF formulation complying with AAMA 2605.

2.2.5.2 Color

Provide custom color as indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Install overhead coiling door assembly, anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories in accordance with approved detail drawings and manufacturer's written instructions. Upon completion of installation, ensure doors are free from all distortion.

Install overhead coiling doors, motors, hoods, and operators at the mounting locations as indicated for each door in the Contract Documents and as required by the manufacturer.

Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility and as required by the manufacturer.

3.1.1 Field Painted Finish

Ensure field painted steel frames are in accordance with Section 09 90 00 PAINTS AND COATINGS and the manufacturer's written instructions. Protect the weather stripping from paint. Ensure that the finishes are free of scratches or other blemishes.

3.2 ADJUSTING AND CLEANING

3.2.1 Acceptance Provisions

After installation, adjust the hardware and moving parts. Lubricate bearings and sliding parts as recommended by manufacturer to provide smooth operating functions for ease movement, free of warping, twisting, or distortion of the door assembly.

Adjust seals to provide a weather-tight fit around entire perimeter.

Engage a factory-authorized service representative to perform startup service and checks according to the manufacturer's written instructions.

Test the door opening and closing operation when activated by controls system. Adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Reset the door-closing mechanism after a successful test.

Test and make final adjustment of new doors at no additional cost to the Government.

3.2.1.1 Maintenance and Adjustment

Not more than 90 calendar days after completion and acceptance of the project, examine, lubricate, test, and re-adjust doors as required for proper operation.

3.2.1.2 Cleaning

Clean doors in accordance with manufacturer's approved instructions.

-- End of Section --

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SECTION 08 34 73

SOUND CONTROL DOOR ASSEMBLIES

11/19, CHG 1: 02/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3/D1.3M (2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

ASTM A108 (2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

ASTM A568/A568M (2019a) Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

ASTM A1008/A1008M (2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

ASTM A1011/A1011M (2018a) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

ASTM C143/C143M (2020) Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C476 (2020) Standard Specification for Grout for Masonry

ASTM C1036 (2016) Standard Specification for Flat Glass

ASTM D1056 (2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

ASTM D6386 (2016a) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron

and Steel Product and Hardware Surfaces
for Painting

ASTM E90 (2009; R2016) Standard Test Method for
Laboratory Measurement of Airborne Sound
Transmission Loss of Building Partitions
and Elements

ASTM E336 (2020) Standard Test Method for
Measurement of Airborne Sound Attenuation
between Rooms in Buildings

ASTM E413 (2016) Classification for Rating Sound
Insulation

ASTM E1289 (2008; R 2016) Standard Specification for
Reference Specimen for Sound Transmission
Loss

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2021) Life Safety Code

NFPA 252 (2017) Standard Methods of Fire Tests of
Door Assemblies

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 Americans with Disabilities Act (ADA)
Accessibility Guidelines for Buildings and
Facilities; Architectural Barriers Act
(ABA) Accessibility Guidelines

WOODWORK INSTITUTE (WI)

NAAWS 3.1 (2017; 2018 Errata Edition) North American
Architectural Woodwork Standards

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S"
classification. Submittals not having a "G" or "S" classification are for
Contractor Quality Control approval. Submit the following in accordance
with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

SD-03 Product Data

Hollow Metal Sound Retardant Doors; G

Wood Sound Retardant Doors; G

Door Frames; G

Door Hardware; G

Door Frame Sound Infill; G

Vision Panels; G

Intumescent Seals and Gasketing; G

Thresholds; G

SD-06 Test Reports

Acoustical Tests; G

Air Infiltration Tests; G

Positive Pressure Tests; G

SD-07 Certificates

Hollow Metal Sound Retardant Doors; G

Wood Sound Retardant Doors; G

Door Frames; G

Door Hardware; G

Vision Panels; G

Intumescent Seals, Gasketing and Door Bottoms; G

Thresholds

Assembly Test Reports

EPD(s); S

Recycled Content; S

Regional Material; S

Forest Stewardship Council (FSC) Certification; S

VOC Emissions; S

Formaldehyde Emissions; S

Legal Wood; S

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of door materials.

Provide regional material certifications for all materials that apply.

Provide Forest Stewardship Council (FSC) Certification for wood products.

1.3.3 IEQ Low Emitting Materials

For doors applied inside the weatherproofing system - submit statement indicating compliance with the;

a. VOC Emissions Evaluation

For Composite Wood applied inside the weatherproofing system - submit statement indicating compliance with the;

a. Formaldehyde Emissions Evaluation

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

1.3.4 Pilot Credit Legal Wood

Submit product data verifying product is from Legal and Responsible Sources per ASTM D7612-10 as required to achieve LEED credit.

1.4 QUALITY CONTROL

Ensure work within this section is designed and furnished by one manufacturer, who has been engaged in the manufacture of Sound Retardant Wood Swinging Door and Hollow Metal Door systems for at least five years prior to the start of this work.

Provide acoustic assemblies manufactured by a single source specializing in the production of this type work for a minimum of five years.

1.4.1 Compliance and Labeling

1.4.1.1 Compliance with Accessibility Requirements

Americans with Disabilities Act/Architectural Barriers Act (ADA/ABA)
36 CFR 1191

Accessibility Guidelines for Buildings and Facilities (ADAAG) 36 CFR 1191

1.4.1.2 Category A Positive Pressure Fire Door Construction

Where requirements for positive pressure are met, include for doors all requirements as part of the door construction per Category A guidelines as published by ITS/Warnock-Hersey. Intumescent is not allowed on the frame. Applying smoke gasketing around the perimeter of the frame to meet the "S" smoke rating is permissible in instances where smoke control is required.

1.4.1.3 Category B Positive Pressure Fire Door Construction

Conform all door openings to the applicable portions of NFPA 101 and

NFPA 252. Incorporate field applied intumescent materials, applied by a licensed installer according to the manufacturers' instructions. Keep instructions on file. Additional gasketing may be required to meet the 'S' smoke rating. Submit Certificate for intumescent seals, gasketing and door bottoms.

1.4.1.4 Labeling

Ensure all positive pressure door assemblies carry the fire label for the complete opening, clearly identifying the:

- a. Manufacturer
- b. Third party testing and certification agency
- c. Fire door rating
- d. Installation limitations
- e. Compatible frame, hardware component ratings
- f. Compatible lite or vision panel component ratings
- g. Required building code information, including temperature and smoke rating
- h. STC rating if required.

Indicate fire-ratings of applicable components. Provide documentation of ABA/ADA accessibility compliance of applicable components, as required by 36 CFR 1191 Appendix D - Technical.

1.5 DELIVERY, STORAGE, AND HANDLING

Ship all doors in the manufacturer's undamaged individual cartons, securely bundled and wrapped with moisture-resistant covers and stored in accordance with the manufacturer's printed instructions in a dry, clean, and ventilated area.

Deliver and store wood doors in the building following the installation of concrete, terrazzo, plaster, or other wet materials, and only after the building has dried out and has a roof.

Store all materials on planks in a dry location. Store doors and frames vertically with minimum 1 inch airspace between. Store doors on the edge to eliminate any potential damage to the door bottom seal. Cover all material to protect from damage but in a manner to allow proper circulation.

Maintain relative humidity in the building between 30 and 65 percent. Maintain the ambient temperature at 60 degrees F minimum at the time of installation of wood doors.

Perform final adjustment of seals when temperatures and humidity conditions replicate the interior conditions that will exist when the building is occupied.

1.6 WARRANTY

Manufacturer's warranty for 5 years from date of supply, covering material and workmanship. Failures include, but are not limited to, the following:

- a. Failure to meet sound rating requirements
- b. Faulty operation of sound seals
- c. Deterioration of metals, metal finishes, and other materials beyond normal use or weathering.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide sound retardant door assemblies of the thickness, width, and height indicated, complete with perimeter seals, seal housings, gasketing, automatic door bottoms, thresholds, door frames, and astragals as required to conform to the specified STC per ASTM E90 and ASTM E1289.

Submit fabrication drawings for Hollow Metal Sound Retardant Doors, Wood Sound Retardant Doors, Door Frames and Door Frame Sound Infill.

Submit certificates showing conformance with the referenced standards in this section, and manufacturer's catalog data including STC ratings and UL fire rating, where applicable, for the following items: Hollow metal sound retardant doors; wood sound retardant doors; door frames; door hardware; vision panels; intumescent seals and gasketing and thresholds.

Provide assemblies that are complete with metal frame, wood door(s), sealing system, and Cam-lift hinges (when required). If vision lights are specified for doors, provide metal loose stops and field install glass and glazing when shipped separately.

2.1.1 Design Requirements

Door assembly exterior appearance must match other interior door assemblies as specified in 08 14 00 WOOD DOORS and 08 11 13 STEEL DOORS AND FRAMES.

2.1.1.1 Door Design

Provide Sound Retardant Swinging Doors that are a 1-3/4-inch thickness construction with sizes as indicated on drawings. No visible seams are permitted on door faces. Provide face gauges, internal sound retardant core and perimeter door edge construction per manufacturer's standard for the specified STC rating. No lead or asbestos is permitted in door construction to achieve performance requirements.

2.1.1.2 Frame Design

Provide Sound Retardant Metal Frames conforming to ASTM A1008/A1008M, not less than 0.0747-inch thick, and free from pitting, scale, stretcher strains, fluting, and surface defects with integral trim and shipped with temporary spreader. Knockdown frames are not acceptable.

Provide frames with 2 inch faces, profiles and dimensions as indicated, with mitered reinforced corners, welded the full depth of frame and trim,

with exposed surfaces ground smooth and flush. Close contact edges to hairline joints.

2.1.2 Performance Requirements

2.1.2.1 STC (Sound Transmission Classification) Rating

Provide doors with an STC per the door schedule.

2.2 FABRICATION

Provide doors that are minimum 16 gauge, 1 3/4 inch thick with welded, seamless construction. No visible joints are permitted on the exposed faces or edges. Join door skins at vertical edges by continuous welds, ground and dressed smooth to provide a flush finish. Reinforce top and bottom with 16 gauge continuous inverted steel channels spot welded to both faces. Finish both top and bottom to provide a smooth flush condition. Bevel both vertical edges 1/8 inch in 2 inches.

Clean and sand to smooth finish all doors to remove handling and storage marks, raised grain, minor surface marks and abrasions which are to receive a job site finish.

2.2.1 Hollow Metal Sound Retardant Doors

2.2.1.1 Construction

Conform to ASTM A1008/A1008M for door construction utilizing steel facing sheets. Conform stretcher level flatness to ASTM A568/A568M; not less than 0.0598 inch thick; free from pitting, scale, and surface defects; separated by a core construction designed to meet the required STC; and tested and rated in accordance with ASTM E90.

Provide doors that have flush seamless face sheets and vertical edges, with continuous welded and smooth joints. Provide edges that are flush or rabbeted as required for perimeter seals.

Provide door surfaces that are visually flat and free from warp, waviness, and other surface irregularities and defects. Maximum allowable warp or twist-can not exceed 1/8 inch when measured with a 7 foot straightedge along the diagonal and not exceed 1/16 inch when measured with a 7 foot straightedge in the width or in any position along the length of the door.

Provide hardware reinforcement that is steel drilled, tapped to template requirements and welded in place. Provide minimum thicknesses as follows:

- a. Butts, 0.1494 inch
- b. Lock strike, 0.1196 inch
- c. Surface applied hardware 0.0747 inch

Provide doors, including sound retardant type, to bear the UL label fire rating and the specified STC as listed in the door schedule.

2.2.1.2 Coating

Thoroughly clean all mill scale, rust, oil, grease, dirt, and other foreign materials from surfaces before the application of the shop coat of

paint.

After cleaning, provide galvanized surfaces free of paint in accordance with ASTM D6386, Method A, B, C, or D.

Apply to clean prepared dry surfaces one shop coat of rust inhibitive metallic oxide or synthetic resin primer by brush, dipping, or other approved method to provide a continuous minimum dry film thickness (dft) of 0.9 mil.

Shop paint the exposed door surfaces, including surfaces that are galvanized.

Shop paint the concealed exterior door surfaces except galvanized surfaces.

2.2.2 Wood Sound Retardant Doors

Construct doors with wood veneer facings separated by a core construction designed to meet the required STC. Test, rate, and label in accordance with ASTM E90.

Comply with the NAAWS 3.1, "Guide Specifications and Quality Certification Program," for premium grade constructions and to the requirements specified.

Perform beveling, prefabricating, machining, mortising, and routing for hardware, perimeter seals, and door bottom cutouts at the mill.

Furnish premium grade door facings with standard thickness face veneers conforming to NAAWS 3.1, Type 1 for stain and transparent job site-applied finish.

2.2.2.1 Faces

Single-ply wood veneer not less than 1/50 inch thick. STC wood doors to match other interior wood doors, see specification 08 14 00 WOOD DOORS.

2.3 COMPONENTS

2.3.1 Frames

Construct frames for Sound Retardant Wood Swinging Doors from formed sheet steel or structural shapes and bars. Provide sheet steel that is commercial quality, level, cold rolled steel conforming to ASTM A1008/A1008M or hot rolled, pickled and oiled steel conforming to ASTM A1011/A1011M. Comply steel shapes with ASTM A36/A36M and steel bars with ASTM A108, Grade 1018.

2.3.2 Door Frame Sound Infill

Grout: Comply with ASTM C476, with a slump of not more than 4 inches as measured according to ASTM C143/C143M.

Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15 mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3.3 Hardware Reinforcements

Factory mortise, reinforce, drill and tap frames for all mortise hardware as required by hardware manufacturer's template. Provide necessary reinforcement plates as required for surface mounted hardware; installer to perform all field drilling and tapping. Provide dust cover boxes on all frame mortises. Provide minimum thicknesses as follows:

- a. Butts, 3/16 inch
- b. Lock strike, 0.1196 inch
- c. Surface applied hardware 0.0747 inch

2.3.4 Jamb Anchors

Provide number and spacing of anchors as follows:

2.3.4.1 Masonry Type

Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

- a) Two anchors per jamb up to 60 inches in height.
- b) Three anchors per jamb from 60 to 90 inches in height.
- c) Four anchors per jamb from 90 to 96 inches in height.
- d) Four anchors per jamb plus one additional anchor per jamb for each 24 inches, or fraction thereof, more than 96 inches in height.

2.3.4.2 Stud-Wall Type

Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

- a) Three anchors per jamb up to 60 inches in height.
- b) Four anchors per jamb from 60 to 90 inches in height.
- c) Five anchors per jamb from 90 to 96 inches in height.
- d) Five anchors per jamb plus one additional anchor per jamb for each 24 inches, or fraction thereof, more than 96 inches in height.
- e) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.

2.3.4.3 Post-installed Expansion Type

Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

2.3.5 Door Hardware

Provide the following STC related hardware with the door; hinges, perimeter seals, door bottoms, thresholds, and hardware standoff brackets.

Include on Fabrication drawings a finish hardware schedule for each door and a hollow metal door frame schedule for each door indicating profile, dimensions, hardware reinforcement, and frame anchorage. Also indicate perimeter seals, door-bottom devices and other hardware items that are assembled in the shop.

Refer to Section 08 71 00 DOOR HARDWARE for remaining hardware requirements.

2.3.6 Vision Panels

Furnish doors with vision panels complete with glazing. Provide 0.0747 inch steel or wood frames, moldings, and stop to match the door finish, with profile indicated. Assemble with mitered corners and flush joints, and secured with countersunk phillips-head screws.

Provide either a single thickness of acoustical plate glass laminated to an inner face of water-clear plastic or multiple thicknesses of 1/4 inch plate glass, clear or patterned as indicated, and set in glazing gaskets and frames as required to meet the specified STC.

Provide glass to conform to ASTM C1036, Type I, Class 1. Provide acoustical plate glass that has been tested and rated in accordance with ASTM E90, with an STC of not less than 36 and a minimum thickness of 9/32 inch.

2.3.7 Head and Jamb Seals

Provide a closed-cell, expanded cellular rubber Seal material conforming to ASTM D1056, Type S, Grade SBE-42 or SCE-42 for heads, jambs, and door bottoms.

Install seals in formed steel or extruded aluminum shapes designed to receive and hold seals and to provide concealed adjustable attachment to door frames. Provide concealed adjustment screws that are not more than 12 inches on center and provide at least 3/8 inch adjustment.

2.3.8 Door Bottoms

Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.

2.3.8.1 Automatic Door Bottoms

Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.

Mounting: Mortised or semimortised into bottom of door as required by testing to achieve STC rating indicated.

2.3.9 Thresholds

Provide metal thresholds where indicated. Provide thresholds that are extruded aluminum, 6063-T5 alloy, mill finish, not less than 1/8 inch thick, with integral seal grooves formed to the indicated section.

Provide flat, smooth, unfluted thresholds as recommended by manufacturer; fabricated from aluminum.

- a. Finish: Clear anodic finish.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

2.4.1 Sound Transmission Classification

Provide test reports prepared by a nationally recognized, independent laboratory for Acoustical Tests, Air Infiltration Tests, Wind Loading Tests, and Water Leakage Tests indicating that the sound transmission classification (STC) of the proposed door, based on tests at 16 third-octave band frequencies from 125 to 4,000 hertz, is no less than the specified STC when tested in accordance with ASTM E90, and that the door tested is hung in substantially the type of wall and frame as indicated and is fully operable with hardware and perimeter seals installed.

2.4.2 Positive Pressure

Provide test reports, prepared by a nationally recognized, independent laboratory for Positive Pressure Tests, for all fire rated door assemblies, including Intumescent Seals, Gasketing, and Door Bottoms.

2.4.3 Cam Lift Hinges

When required to achieve STC, manufacturer to furnish laboratory test data certifying hinges have been cycled a minimum of 1,000,000 while supporting a minimum door weight of 350 pounds.

Full-mortise template type that raises the door 1/2 inch when door is fully open; with hardened pin; fabricated from stainless steel.

2.4.4 Guarantee

Provide written guarantee that each door delivered to the project is equal in construction, sound transmission classification (STC), and positive pressure test rating where applicable, with appropriate labeling and markings, to that of the sample door tested. Clearly state in written guarantee that each door assembly, when installed in accordance with the manufacturer's printed instructions, has an in-place STC within 3 decibels of the specimen tested. Submit the following test data and Certificates with the written Guarantee:

- a. Acoustical Tests
- b. Air Infiltration Tests
- c. Positive Pressure Tests

PART 3 EXECUTION

3.1 PREPARATION

Upon receipt of material, thoroughly inspect all frames, doors and accessories. Verify quantities and tag numbers according to the packing list provided. Report all discrepancies, deficiencies and/or damages immediately to Contracting Officer.

Prior to installation check all doors and frames for correct size and swing. Verify that frames are plumb, square and aligned without twist in

accordance with tolerances published by NAAMM/HMMA and SDI.

3.1.1 Frame Painting and Cleaning

Clean thoroughly all surfaces of all mill scale, rust, oil, grease, dirt, and other foreign materials before the application of the shop coat of paint.

Apply one shop coat of rust inhibitive metallic oxide or synthetic resin primer applied to clean, dry, and prepared surfaces by brush, dipping, or other approved method to provide a continuous minimum dry film thickness of 0.9 mil.

3.2 INSTALLATION

3.2.1 Frame

Install frames plumb and true with not more than 1/32 inch deviation in vertical alignment in 8 feet. Anchor to the wall in accordance with the manufacturer's instructions. Grout frames solid with mortar in masonry, concrete, and plaster wall construction. Spot grout frames in dry wall partitions with mortar at the jamb anchor clips; fill the space between metal frame and stud partition solidly with fiberglass or mineral wool insulation.

Field splices may be required after installation because of shipping limitations. Field weld splices by certified welders per manufacturer's instructions and in accordance with AWS D1.3/D1.3M.

3.2.2 Door

Install and adjust all doors, hardware, and seals in accordance with the approved drawings, hardware schedules, and the printed instructions of the door manufacturer.

Install and adjust perimeter seals and automatic door bottom seals to provide positive compression contact with the entire sealing surface with no gaps, openings, or breaks. Hinges or hardware which distort or pinch the perimeter seal during operation of the door will be rejected.

Install door bottom devices to seal the space between the door bottoms and the finished floor and the space between the seal and seal housing.

Field apply perimeter seal housings with mitered corners and with flush, aligned hairline joints.

Install components to manufacturer's written instructions. Coordinate with masonry and gypsum board wall construction for anchor placement. Set frames plumb, square, level and at correct elevation. Adjust operable parts for correct clearances and function. Install and adjust perimeter and bottom acoustic seals.

3.3 FIELD QUALITY CONTROL

Provide third party testing in accordance with ASTM E336. Verify in writing that installed product performs no less than five (5) ASTC or NIC rating points below the specified laboratory STC rating. Examine, adjust, and retest any installation not meeting that criteria until compliance is obtained.

3.3.1 Testing and Performance

Provide assemblies that are identical to those tested at an independent acoustical laboratory qualified under the National Voluntary Laboratory Accreditation Program (NVLAP) by the National Institute for Science and Technology (NIST) in accordance with ASTM E90 and ASTM E413. For the assembly test reports include the laboratory name, test report number and date of test.

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SECTION 08 51 13

ALUMINUM WINDOWS

05/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 1503	(2009) Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
AAMA 2605	(2020) Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
AAMA WSG.1	(1995) Window Selection Guide
AAMA/WDMA/CSA 101/I.S.2/A440	(2017) North American Fenestration Standard/Specification for Windows, Doors, and Skylights

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 169	(2013) Climate Data for Building Design Standards
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ASTM INTERNATIONAL (ASTM)

ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM D2244	(2016) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM E90	(2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E413	(2016) Classification for Rating Sound Insulation

ASTM E1300	(2016) Standard Practice for Determining Load Resistance of Glass in Buildings
ASTM E1332	(2016) Standard Classification for Rating Outdoor-Indoor Sound Attenuation
ASTM E1886	(2019) Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
ASTM E1996	(2017) Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
ASTM F2248	(2012) Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass

INTERNATIONAL WINDOW CLEANING ASSOCIATION (IWCA)

IWCA I-14.1	(2001) Window Cleaning Safety Standard
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NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(2017) Procedure for Determining Fenestration Product U-Factors
NFRC 200	(2017) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Windows; G

Fabrication Drawings

SD-03 Product Data

Windows; G

Fasteners; G

Window Performance; G

Thermal-Barrier Windows; G

Mullions; G

Window Cleaners' Bolts; G

Accessories; G

Adhesives

Thermal Performance; G

SD-04 Samples

Finish Sample

Window Mock-Ups; G

SD-05 Design Data

Structural Calculations for Deflection; G

Design Analysis; G

SD-06 Test Reports

Minimum Condensation Resistance Factor

Windborne-Debris-Impact Performance

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

SD-10 Operation and Maintenance Data

Windows, Data Package 1

Submit in accordance with Section 01 78 23 OPERATION AND
MAINTENANCE DATA.

Plastic Identification

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29
requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for aluminum windows.

.Provide regional material certifications of applicable materials.

1.2.1.3 IEQ Low-Emitting Materials

For windows applied inside the weatherproofing system - submit VOC statement indicating compliance with the; a. VOC Emissions Evaluation.

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.3 QUALITY ASSURANCE

1.3.1 Qualification of Manufacturer

Window manufacturer must specialize in designing and manufacturing the type of aluminum windows specified in this section, and have a minimum of 10 years of documented successful experience. Manufacturer must have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.3.2 Shop Drawing Requirements

Take field measurements prior to preparation of drawings and fabrications. Provide drawings that indicate elevations of windows, full-size sections, thickness and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of mullion window cleaner anchors, installation details, and other related items.

1.3.3 Sample Requirements

1.3.3.1 Finish Sample Requirements

Submit color chart of standard factory color coatings when factory-finish color coating is to be provided.

1.3.3.2 Mock-Ups

Before fabrication, full-size mock-up of one window unit complete with glass and AAMA certification label for structural purposes and NFRC Temporary and Permanent Label for certification of thermal performance rating will be required for review of window construction.

1.3.4 Design Data Requirements

Submit calculations to substantiate compliance with deflection requirements. A registered Professional Engineer must provide calculations.

Submit design analysis with calculations showing that the design of each different size and type of aluminum window unit and its anchorage to the

structure. Calculations verifying the structural performance of each window proposed for use, under the given loads, must be prepared and signed by a registered professional engineer. Reflect the window components and anchorage devices to the structure, as determined by the design analysis, in the shop drawings.

1.3.5 Test Report Requirements

Submit test reports for each type of window attesting that identical windows have been tested and meet the requirements specified herein for conformance to AAMA/WDMA/CSA 101/I.S.2/A440 including test size, and minimum condensation resistance factor (CRF).

1.3.6 Certification

Ensure that construction is performed with products that meet or exceed Energy Star criteria, and be current in their certification.

Each prime window unit must bear the AAMA Label warranting that the product complies with AAMA/WDMA/CSA 101/I.S.2/A440. Certified test reports attesting that the prime window units meet the requirements of AAMA/WDMA/CSA 101/I.S.2/A440, including test size, will be acceptable in lieu of product labeling.

1.4 DELIVERY AND STORAGE

Deliver windows to project site in an undamaged condition. Use care in handling and hoisting windows during transportation and at the jobsite. Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending, warping, or otherwise damaging the windows. Repair damaged windows to an "as new" condition as approved. If windows can not be repaired, provide a new unit.

1.5 PLASTIC IDENTIFICATION

Label plastic products provided to indicate their polymeric composition according to the following list. Where products are not labeled, provide product data indicating polymeric information in Operation and Maintenance Manual.

- a. Type 1: Polyethylene Terephthalate (PET, PETE).
- b. Type 2: High Density Polyethylene (HDPE).
- c. Type 3: Vinyl (Polyvinyl Chloride or PVC).
- d. Type 4: Low Density Polyethylene (LDPE).
- e. Type 5: Polypropylene (PP).
- f. Type 6: Polystyrene (PS).
- g. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

1.6 PERFORMANCE REQUIREMENTS

1.6.1 Wind Loading Design Pressure

Design window components, including mullions and anchors, to withstand a wind-loading design pressure of at least pounds per square foot (psf) as identified on drawings.

1.6.2 Tests

Test windows proposed for use in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 for the particular type and quality window specified.

Perform tests by a nationally recognized independent testing laboratory equipped and capable of performing the required tests. Submit the results of the tests as certified laboratory reports required herein.

Minimum design load for a uniform-load structural test must be 50 psf.

AAMA WSG.1 for air infiltration, water resistance, uniform-load deflection, and uniform-load structural test.

1.7 DRAWINGS

Submit the Fabrication Drawings for aluminum window units showing complete window assembly subframe assembly details.

1.8 WINDOW PERFORMANCE

Aluminum windows must meet the following performance requirements. Perform testing requirements by an independent testing laboratory or agency.

1.8.1 Structural Performance

Structural test pressures on window units must be for positive load (inward) and negative load (outward). After testing, there will be no glass breakage, permanent damage to fasteners, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There must be no permanent deformation of any main frame in excess of the requirements established by AAMA/WDMA/CSA 101/I.S.2/A440 for the window types and classification specified in this section.

1.8.2 Air Infiltration

Air infiltration must not exceed the amount established by AAMA/WDMA/CSA 101/I.S.2/A440 for each window type.

1.8.3 Water Penetration

Water penetration must not exceed the amount established by AAMA/WDMA/CSA 101/I.S.2/A440 for each window type.

1.8.4 Thermal Performance

Windows (including frames and glass) will be independently tested and certified with a Solar Heat Gain Coefficient (SHGC) determined according to NFRC 200 procedures and a whole window U-factor determined in

accordance with NFRC 100 within the ranges as indicated below according to the ASHRAE 169 Climate Zone of the project location. Provide visual Transmittance (VT) of 0.5 or greater. Submit documentation supporting compliance with Energy Star qualifications as applicable. Exterior window assemblies, including glazing, to have a U-Factor and SHGC as noted on drawings.

1.8.5 Sound Attenuation

When tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or the following below, provide a minimum Sound Transmission Class (STC) of 35 in accordance with ASTM E90 and as determined by ASTM E413 or Outside-Indoor Transmission Class (OITC) of 25 in accordance with ASTM E1332 and as determined by ASTM E413 with the window glazed with 1/2 inch air space between two pieces of 1/4 inch.

1.8.6 Windborne-Debris-Impact Performance

Exterior window system including glazing must comply with indicated basis or enhanced protection testing requirements in ASTM E1996 for Wind Zone 1 when tested according to ASTM E1886. Test specimens must be no smaller in width and length than glazing indicated for use on Project and must be installed in same manner as glazing indicated for use on Project.

- a. Refer to drawings for classification of window requiring basic or enhanced protection.
- b. Large-Missile Test: For glazing located within 30 feet of grade.

1.9 WARRANTY

Provide Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

1.9.1 Manufacturer's Finish Warranty

Provide a manufacturer's no-dollar-limit 20 year warranty for the window system. Issue the warranty directly to the Government at the date of Government acceptance, warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D2244.

PART 2 PRODUCTS

2.1 WINDOWS

Provide prime windows that comply with AAMA/WDMA/CSA 101/I.S.2/A440 and the requirements specified herein. In addition to compliance with AAMA/WDMA/CSA 101/I.S.2/A440, window framing members for each individual light of glass must not deflect to the extent that deflection perpendicular to the glass light exceeds L/175 of the glass edge length when subjected to uniform loads at specified design pressures. Provide Structural calculations for deflection to substantiate compliance with deflection requirements. Provide windows of types, performance classes, performance grades, combinations, and sizes indicated or specified. Provide aluminum window frames with a minimum recycled content of 20 percent. Provide data identifying percentage of recycled content of

aluminum windows. Design windows to accommodate glass, and accessories to be furnished. Each window must be a complete factory assembled unit with or without glass installed. Dimensions shown are minimum. Provide windows with insulating glass and thermal break necessary to achieve a minimum Condensation Resistance Factor (CRF) of 48 when tested in accordance with AAMA 1503.

2.1.1 Fixed Windows (F)

Type as required to meet design pressures as indicated on structural drawings.

2.1.2 Glass and Glazing

Materials are specified in Section 08 81 00 GLAZING.

2.1.3 Caulking and Sealing

Are specified in Section 07 92 00 JOINT SEALANTS.

2.2 FABRICATION

Fabrication of window units must comply with AAMA/WDMA/CSA 101/I.S.2/A440.

2.2.1 Provisions for Glazing

Design windows and rabbets suitable for glass thickness shown or specified.

2.2.2 Fasteners

Use window manufacturer's standard for windows, trim, and accessories. Self-tapping sheet-metal screws are not acceptable for material more than 1/16 inch thick.

2.2.3 Adhesives

Provide joint sealants as specified in Section 07 92 00 JOINT SEALANTS. For interior application of joint sealants, comply with applicable regulations regarding reduced VOC's, and as specified in Section 07 92 00 JOINT SEALANTS.

2.2.4 Drips and Weep Holes

Provide continuous drips over heads of top ventilators. Where fixed windows adjoin ventilators, drips must be continuous across tops of fixed windows. Provide drips and weep holes as required to return water to the outside.

2.2.5 Mullions and Transom Bars

Provide mullions between multiple window units to resist two times (2X) glazing resistance in accordance with ASTM F2248 and ASTM E1300. Provide mullions with a thermal break. Secure mullions and transom bars to adjoining construction and window units in such a manner as to permit expansion and contraction and to form a weathertight joint. Where window cleaner anchors are required, reinforce mullions and anchor to adjoining construction so as to provide safe and adequate support. Provide mullion covers on the interior and exterior to completely close exposed joints and recesses between window units and to present a neat appearance. Provide

special covers over structural support at mullions as indicated.

2.2.6 Accessories

Provide windows complete with necessary fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation. Furnish extruded aluminum subframe receptors and subsill with each window unit.

2.2.6.1 Fasteners

Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners must be compatible with the window and the adjoining construction. Provide a minimum of three anchors for each jamb located approximately 6 inches from each end and at midpoint.

2.2.6.2 Window-Cleaner Anchors

Provide double head anchors for windows specified. Anchors must be stainless steel of size and design required for the window type and application, conforming to ASTM A276/A276M. Provide two anchors for each single window and each adjacent fixed glass window unit. Fasten anchors 44 inches above the window sill utilizing appropriate methods for the window type and application in accordance with industry safety standards.

2.2.6.3 Window Anchors

Anchoring devices for installing windows must be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA/WDMA/CSA 101/I.S.2/A440.

2.2.7 Finishes

Comply with NAAMM's "Metal Finishes Manual" for applying and designating finishes. Exposed aluminum surfaces must be factory finished with an organic coating. Color must be as indicated on drawings. All windows must have the same finish.

2.2.7.1 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a high-performance finish in accordance with AAMA 2605 with total dry film thickness of not less than 1.2 mils.

2.3 THERMAL-BARRIER WINDOWS

Provide thermal-barrier windows, complete with accessories and fittings, where indicated.

Specify material and construction except as follows:

- a. Aluminum alloy must be 6063-T6.
- b. Frame construction must be factory-assembled and factory-sealed inner and outer aluminum completely separated from metal-to-metal contact. Join assembly by a continuous, concealed, low conductance divider housed in an interlocking extrusion of the inner frame. Metal fasteners, straps, or anchors must not bridge the connection between

the inner and outer frame.

2.4 MULLIONS

Provide mullions between multiple-window units where indicated.

Provide profiles for mullions and mullion covers, reinforced as required for the specified wind loading, and securely anchored to the adjoining construction. Mullion extrusion will include serrations or pockets to receive weatherstripping, sealant, or tape at the point of contact with each window flange.

Mullion assembly must include aluminum window clamps or brackets screwed or bolted to the mullion and the mullion cover.

Mullion cover must be screw-fastened to the mullion unless otherwise indicated.

Mullion reinforcing members must be fabricated of the materials specified in AAMA/WDMA/CSA 101/I.S.2/A440 and meet the specified design loading.

2.5 WINDOW CLEANERS' BOLTS

Provide window cleaners' bolts for all windows 7 feet or higher above finished grade, except for windows that can be removed and cleaned from the ground or from a lower roof level without the use of an extension ladder. Provide two bolts for each single window unit and each fixed glass unit. Locate bolts 44 inches above the window sill.

Window cleaners' bolts must be double-head type, AISI Series 300 corrosion-resistant steel, size and design complying with IWCA I-14.1. Contact side of the bolts must be ground to fit flat against window jambs. Bolts must be factory- or field-attached before windows are set. Reinforce backs of frames to receive bolts with 1/4 by 6-inch corrosion-resistant steel or aluminum plates bolted or welded to the frames at the factory. Special wall anchors must be provided on frames at the point of bolt attachment.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Method of Installation

Install in accordance with the window manufacturer's printed instructions and details. Build in windows as the work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location, and reveal; plumb, square, level, and in alignment; and brace, strut, and stay properly to prevent distortion and misalignment. Protect ventilators and operating parts against accumulation of dirt and building materials by keeping ventilators tightly closed and locked to frame. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install and caulk windows in a manner that will prevent entrance of water and wind. Fasten insect screens securely in place.

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

3.1.2 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to masonry, concrete, wood, or dissimilar metals, except stainless steel or zinc, protect the aluminum surface from dissimilar materials as recommended in the Appendix to AAMA/WDMA/CSA 101/I.S.2/A440. Do not coat surfaces in contact with sealants after installation with any type of protective material. Do not apply coatings or lacquers to surfaces to which caulking and glazing components must adhere.

3.1.3 Anchors and Fastenings

Make provision for securing units to each other, to masonry, and to other adjoining construction. Windows installed in masonry walls must have head and jamb members designed to recess into masonry wall not less than 7/16 inch.

3.1.4 Adjustments After Installation

After installation of windows and completion of glazing. Verify that products are properly installed, connected, and adjusted.

3.2 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces. Replace all stained, discolored, or abraded windows that cannot be restored to their original condition with new windows.

-- End of Section --

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SECTION 08 71 00

DOOR HARDWARE
02/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E283	(2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
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ASTM F883	(2013) Padlocks
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BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	(2016) Butts and Hinges
ANSI/BHMA A156.2	(2017) Bored and Preamsembled Locks and Latches
ANSI/BHMA A156.3	(2014) Exit Devices
ANSI/BHMA A156.4	(2013) Door Controls - Closers
ANSI/BHMA A156.5	(2020) Cylinder and Input Devices for Locks
ANSI/BHMA A156.6	(2015) Architectural Door Trim
ANSI/BHMA A156.7	(2016) Template Hinge Dimensions
ANSI/BHMA A156.8	(2015) Door Controls - Overhead Stops and Holders
ANSI/BHMA A156.13	(2017) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.14	(2013) Sliding Door Hardware
ANSI/BHMA A156.15	(2015) Release Devices Closer Holder, Electromagnetic and Electromechanical
ANSI/BHMA A156.16	(2018) Auxiliary Hardware
ANSI/BHMA A156.17	(2019) Self Closing Hinges & Pivots
ANSI/BHMA A156.18	(2016) Materials and Finishes
ANSI/BHMA A156.21	(2019) Thresholds

ANSI/BHMA A156.22	(2017) Door Gasketing and Edge Seal Systems
ANSI/BHMA A156.23	(2010) Electromagnetic Locks
ANSI/BHMA A156.25	(2013) Electrified Locking Devices
ANSI/BHMA A156.26	(2012) Continuous Hinges
ANSI/BHMA A156.29	(2012) Exit Locks, Exit Alarms, Alarms for Exit Devices
ANSI/BHMA A156.30	(2014) High Security Cylinders
ANSI/BHMA A156.31	(2013) Electric Strikes and Frame Mounted Actuators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 72	(2022) National Fire Alarm and Signaling Code
NFPA 80	(2019) Standard for Fire Doors and Other Opening Protectives
NFPA 101	(2021) Life Safety Code
NFPA 252	(2017) Standard Methods of Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	(2017) Specifications for Standard Steel Doors and Frames
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines
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UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(updated continuously online) Building Materials Directory
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Manufacturer's Detail Drawings; G

Verification of Existing Conditions; G

Hardware Schedule; G

Keying System; G

SD-03 Product Data

Hardware Items; G

SD-07 Certifications

EPD(s); S

Recycled Content; S

Regional Material; S

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule Items, Data Package 1; G

SD-11 Closeout Submittals

Key Bitting

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for door hardware. Provide regional material certifications of applicable materials.

1.4 SHOP DRAWINGS

Submit manufacturer's detail drawings indicating all hardware assembly components and interface with adjacent construction. Indicate power components and wiring coordination for electrified hardware. Base shop drawings on verified field measurements and include verification of existing conditions.

1.5 PRODUCT DATA

Indicate fire-ratings at applicable components. Provide documentation of ABA/ADA accessibility compliance of applicable components, as required by 36 CFR 1191 Appendix D - Technical.

1.6 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr Name and Catalog No.	Key Control Symbols	UL Mark (If fire-rated and listed)	BHMA Finish Designation

In addition, submit hardware schedule data package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.7 KEY BITTING CHART REQUIREMENTS

1.7.1 Requirements

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

- Complete listing of all keys (e.g. AA1 and AA2).
- Complete listing of all key cuts (AA1-123456, AA2-123458).
- Tabulation showing which key fits which door.
- Copy of floor plan showing doors and door numbers.
- Listing of 20 percent more key cuts than are presently required in each master system.

1.8 QUALITY ASSURANCE

1.8.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, pivots, and closers of one lock, hinge, pivot, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.8.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Contracting Officer, Contractor, Door Hardware Subcontractor, using Activity and Base Locksmith must meet to discuss and coordinate key requirements for the facility.

1.9 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each

individual container with item number as shown on hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware applied to metal or to prefinished doors must be manufactured using a template. Provide templates to door and frame manufacturers in accordance with ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, NFPA 252 for fire tests of door assemblies, ABA/ADA accessibility requirements, and all other requirements indicated, even if such hardware is not specifically mentioned in paragraph HARDWARE SCHEDULE. Provide Underwriters Laboratories, Inc. labels for such hardware in accordance with UL Bld Mat Dir or equivalent labels in accordance with another testing laboratory approved in writing by the Contracting Officer.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark is visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover. Coordinate electrified door hardware components with corresponding components specified in Division 28 ELECTRONIC SECURITY SYSTEMS (ESS).

2.3.1 Hinges

Provide in accordance with ANSI/BHMA A156.1. Provide hinges that are 4-1/2 by 4-1/2 inch unless otherwise indicated. Construct loose pin hinges for interior doors and reverse-bevel exterior doors so that pins are non-removable when door is closed. Other anti-friction bearing hinges may be provided in lieu of ball bearing hinges.

2.3.2 Continuous Hinges

Where continuous hinges are required, provide in accordance with ANSI/BHMA A156.26.

2.3.3 Pivots

Provide in accordance with ANSI/BHMA A156.17.

2.3.4 Locks and Latches

- a. At exterior locations provide locksets of full stainless steel type 302 or 304 construction including fronts, strike, escutcheons, knobs, bolts and all interior working parts. Marine Grade I, fully non-ferrous.
- b. In non-air-conditioned interior environments or humid interior

environments, provide interior locksets on the same Marine Grade I, fully non-ferrous as exterior locksets.

2.3.4.1 Mortise Locks and Latches

Provide in accordance with ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 7 by 2-1/4 inch with a bushing at least 1/4 inch long. Cut escutcheons to fit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Provide knobs and roses of mortise locks with screwless shanks and no exposed screws.

2.3.4.2 Bored Locks and Latches

Provide in accordance with ANSI/BHMA A156.2, Series 4000, Grade 1.

2.3.5 Exit Devices

Provide in accordance with ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Provide touch bars in lieu of conventional crossbars and arms. Provide escutcheons not less than 7 by 2-1/4 inch.

Use stainless steel or bronze base metal with plated finishes. Also include stainless steel fasteners and screws.

2.3.6 Exit Locks With Alarm

Provide in accordance with ANSI/BHMA A156.3 and ANSI/BHMA A156.29, Type E0431 (with full width horizontal actuating bar) for single doors; Type E0431 (with actuating bar) or E0471 (with actuating bar and top and bottom bolts, both leaves active) for pairs of doors, unless otherwise specified.

Provide terminals for connection to remote indicating panel. Provide door alarms integrated with the fire alarm system in accordance with NFPA 72.

2.3.7 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with seven pin tumblers. Provide cylinders from the products of one manufacturer, and provide cores from the products of one manufacturer. Rim cylinders, mortise cylinders, and knobs of bored locksets have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.3.7.1 High Security Cylinders

Provide in accordance with ANSI/BHMA A156.30, security level A for all high security cylinder components.

2.3.8 Push Button Mechanisms

Provide in accordance with ANSI/BHMA A156.5, Grade 1.

2.3.9 Electrified Hardware

Comply with the requirements of NFPA 70 for wiring of electrified hardware.

2.3.9.1 Electric Strikes and Frame Mounted Actuators

Provide in accordance with ANSI/BHMA A156.31, Grade 1. Provide electric strikes and actuators as required to meet operational requirements. Provide electric strikes that remain secure during power failure. Provide a separate power supply for electric strikes, other locking devices and ancillary parts. Provide battery backup for continued operation during power failure. Provide strikes and actuators with a minimum opening force of 2300 pounds.

Provide facility interface devices that use direct current (dc) power to energize the solenoids. Provide electric strikes and actuators that incorporate end-of-line resistors to facilitate line supervision by the system. If not incorporated into the electric strike or local controller, provide metal oxide resistors (MOVs) to protect the controller from reverse current surges.

2.3.9.1.1 Solenoid

Provide actuating solenoid for strikes and actuators that are rated for continuous duty, cannot dissipate more than 12 Watts and must operate on 12 or 24 Volts dc. Inrush current cannot exceed 1 ampere and the holding current cannot be greater than 500 milliamperes. Actuating solenoid must move from fully secure to fully open positions in less than 500 milliseconds.

2.3.9.1.2 Signal Switches

Provide strikes and actuators with signal switches to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. Signal switches must report a forced entry to the system.

2.3.9.1.3 Tamper Resistance

Provide strike guards that prevent tampering with the latch bolt of the locking hardware or the latch bolt keeper of the electric strike. Strike guards to bolt through the door using tamper resistant screws. Provide strike guards made of 1/8 inch thick brass and that are 11-1/14 inch high by 1-5/8 inch wide, with a minimum 5/32 inch wide offset.

2.3.9.1.4 Coordination

Provide electric strikes and actuators of a size, weight and profile compatible with each specified door frame. Field verify installation clearances prior to procurement.

2.3.9.1.5 Mounting Method

Provide electric strikes and actuators suitable for use with single and double doors, with mortise or rim type hardware specified, and for right or left hand mounting as specified. In double door installations, locate the lock in the active leaf and monitor the fixed leaf.

2.3.9.2 Electrified Mortise Locks

Provide in accordance with ANSI/BHMA A156.25, Grade 1. Provide electrified mortise locks that remain secure during power failure. Provide facility interface devices that use dc power to energize solenoids. Provide solenoids, resistors, and signal switches in accordance with paragraph ELECTRIC STRIKES AND FRAME MOUNTED ACTUATORS.

2.3.9.2.1 Power Transfer Hinges

Provide power transfer hinges with each electrified lock that route power and monitoring signals from the lockset to the door frame. Coordinate power transfer hinges with door frames.

2.3.9.3 Card Readers and Keypad Access Control Hardware

Coordinate access control hardware with corresponding devices and systems specified in Division 28 ELECTRONIC SECURITY SYSTEMS (ESS).

2.3.9.4 Release Devices

In accordance with ANSI/BHMA A156.15, Grade 1.

2.3.9.4.1 Closer Holders

Provide door mounted closer holder devices connected by integral releasing to fire detecting devices.

2.3.9.5 Electromagnetic Locks

Provide in accordance with ANSI/BHMA A156.23, Grade 1. Provide electromagnetic locks that do not contain any moving parts and depend solely upon electromagnetism to secure a portal by generating at least 1200 pounds of holding force. The lock must interface with the local processors without external, internal or functional alteration of the local processor. The electromagnetic lock must incorporate an end of line resistor to facilitate line supervision by the system. Provide metal-oxide resistors (MOVs) to protect controllers from reverse current surges, if not incorporated into the electromagnetic lock or local controller.

2.3.9.5.1 Armature

Provide electromagnetic locks with internal circuitry to eliminate residual magnetism and inductive kickback. Provide actuating armature that operates on 12 or 24 Volts dc and cannot dissipate more than 12 Watts. Holding current must be less than 500 milliamperes. Actuating armature must take less than 300 milliseconds to change the status of the lock from fully secure to fully open or fully open to fully secure.

2.3.9.5.2 Tamper Resistance

Provide lock mechanism encased in hardened guard barriers to deter forced entry.

2.3.9.5.3 Mounting Method

Provide electromagnetic lock suitable for use with single and double door with mortise or rim type hardware and compatible with right or left hand

mounting.

2.3.10 Keying System

Provide a grand master keying system Provide a construction master keying system.

2.3.11 Lock Trim

Provide cast, forged, or heavy wrought construction and commercial plain design for lock trim.

2.3.11.1 Lever Handles

Provide lever handles where indicated in the Hardware Schedule. Provide in accordance with ANSI/BHMA A156.3 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.3.11.2 Texture

Provide knurled or abrasive coated knobs or lever handles for doors which are accessible to blind persons and which lead to dangerous areas.

2.3.12 Keys

Provide Provide a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - do not duplicate." Do not place room number on keys.

2.3.13 Door Bolts

Provide in accordance with ANSI/BHMA A156.16. Provide dustproof strikes for bottom bolts, except at doors having metal thresholds. Provide automatic latching flush bolts in accordance with ANSI/BHMA A156.3, Type 25.

2.3.14 Closers

Provide in accordance with ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, except at storefront mounting, pivots, and other features necessary for the particular application. Size closers in accordance with manufacturer's printed recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

Use stainless steel inside bracketed or door mounted closers on exterior doors. Non-ferrous closers, such as aluminum or cast bronze, are permissible where door utilization is minimal. On interior doors use closers of 302 or 304 stainless steel or non-ferrous materials. On surface-mounted closers use or apply rust inhibiting finish on all ferrous parts. Also apply this finish on concealed closers.

2.3.14.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation in locations that will be visible after installation.

2.3.15 Overhead Holders

Provide in accordance with ANSI/BHMA A156.8.

2.3.16 Door Protection Plates

Provide in accordance with ANSI/BHMA A156.6.

2.3.16.1 Sizes of Mop and Kick Plates

2 inch less than door width for single doors; 1 inch less than door width for pairs of doors. Provide 10 inch kick plates for flush doors. 6 inch mop plates.

2.3.17 Door Stops and Silencers

Provide in accordance with ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.18 Padlocks

Provide in accordance with ASTM F883.

2.3.19 Thresholds

Provide in accordance with ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.20 Weatherstripping Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide the type and function designation where specified in paragraph HARDWARE SCHEDULE. Provide a set to include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weatherstripped doors not to exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283. Provide weatherstripping with one of the following:

2.3.20.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide anodized aluminum to match door.

2.3.21 Soundproofing Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide adjustable doorstops at heads, jambs and automatic door bottoms in accordance with the hardware set, of extruded aluminum, bronze anodized, surface applied, with vinyl fin seals between plunger and housing. Provide doorstops with solid neoprene tube, silicone rubber, or closed cell sponge gasket. Provide door bottoms with adjustable operating rod and silicone rubber or

closed cell sponge neoprene gasket. Provide doorstops that are mitered at corners. Provide type and function designation where specified in paragraph HARDWARE SETS.

2.3.22 Rain Drips

Provide in accordance with ANSI/BHMA A156.22. Provide extruded aluminum rain drips, not less than 0.08 inch thick, factory painted finish, color to match door and frame. Provide the manufacturer's full range of color choices to the Contracting Officer for color selection. Provide rain drips with a 4 inch overlap on each side of each exterior door that is not protected by an awning, roof, eave or other horizontal projection. Set drips in sealant and fasten with stainless steel screws.

2.3.22.1 Door Rain Drips

Approximately 1-1/2 inch high by 5/8 inch projection. Align bottom with bottom edge of door.

2.3.22.2 Overhead Rain Drips

Approximately 1-1/2 inch high by 2-1/2 inch projection. Align bottom with door frame rabbet.

2.3.23 Auxiliary Hardware (Other than locks)

Provide in accordance with ANSI/BHMA A156.16, Grade 1.

2.3.24 Sliding Door Hardware

Provide in accordance with ANSI/BHMA A156.14, Grade 1. Finishes to match other hardware specified herein.

2.3.24.1 Alum Top Hung Sliding Door System

Provide ceiling mounted heavy glass sliding door system. Overhead track assembly to be extruded alum 6063-T6 prefabricated to support glass panels hung from roller assemblies and run continuously across assembly. Top track to be 3.5 inches high x 2.5 inches wide. Bottom track system to be 1 inch high x 1.75 inch wide. Rollers to provide smooth, silent movement of glass panels, 2 roller assemblies per panel. Provide braking system that cushions the opening and closing of the doors. Conceal braking system in top track. See specification section 08 81 00 for glazing requirements. Coordinate roller assembly carrying capacity with final glazing type/thickness. Polish exposed edges of glazing to a bright flat polish. Temper glass materials horizontally, visible tong marks or tong mark distortions are not permitted.

2.3.24.2 Door Pull

Provide 3 inch projection, 1.24 inch round grip diameter and 30 inch long. Mount door pulls to glass sliding door, back to back.

2.3.25 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, as required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of type, quality, size, and quantity appropriate to the specific application. Fastener finish to match hardware. Provide stainless steel or nonferrous metal fasteners in locations exposed to weather. Verify metals in contact with one another are compatible and will avoid galvanic corrosion when exposed to weather.

2.5 FINISHES

Provide in accordance with ANSI/BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except aluminum paint finish for surface door closers, and except BHMA 652 finish (satin chromium plated) for steel hinges. Provide hinges for exterior doors in stainless steel with BHMA 630 finish. Furnish exit devices in BHMA 626 finish in lieu of BHMA 630 finish except where BHMA 630 is specified under paragraph HARDWARE SETS. Match exposed parts of concealed closers to lock and door trim. Match hardware finish for aluminum doors to the doors.

2.6 High Security Key Lock Box

Provide surface mounted heavy duty, high security key box for the storage of keys as indicated on drawings to facilitate building access by emergency personnel. Unit must include locking mechanism and be sized to store 10 keys. Box must be weather resistant with a hinged door. Surface mounted with fasteners as recommended by lock box manufacturer. Coordinate location with exterior card reader as necessary. Color to be selected from standard colors.

PART 3 EXECUTION

3.1 INSTALLATION

Provide hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weatherstripping Installation

Provide full contact, weathertight seals that allow operation of doors without binding the weatherstripping.

3.1.1.1 Stop Applied Weatherstripping

Fasten in place with color matched sheet metal screws not more than 9 inch on center after doors and frames have been finish painted.

3.1.2 Soundproofing Installation

Provide as specified for stop applied weatherstripping.

3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves. For aluminum thresholds placed on top of concrete surfaces, coat the underside surfaces that are in contact with the concrete with fluid applied waterproofing as a separation measure prior to placement.

3.2 FIRE DOORS AND EXIT DOORS

Provide hardware in accordance with NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, and NFPA 252 for fire tests of door assemblies.

3.3 HARDWARE LOCATIONS

Provide in accordance with SDI/DOOR A250.8, unless indicated or specified otherwise.

- a. Kick Plates: Push side of single-acting doors. Both sides of double-acting doors.
- b. Mop Plates: Bottom flush with bottom of door.

3.4 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, errors in cutting and fitting and damage to adjoining work.

3.5 HARDWARE SETS

Provide hardware for aluminum doors under this section. Deliver Hardware templates and hardware, except field applied hardware, to the aluminum door and frame manufacturer for use in fabricating doors and frames.

The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only, and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware, and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

HARDWARE SETS		
Set: 1.0 Doors: 100		
1	Continuous Hinge (A31331G)	
2	Electric Power Transfer	
1	Concealed Vert Rod Exit, Nightlatch (Type 06, 12)	US32D
1	Concealed Vert Rod Exit, Exit Only (Type 06, 01)	US32D
1	Interchangeable Core (E09241)	26
2	Surface Closer (C02021)	689
2	Blade Stop	689
1	Threshold (J36130)	
2	Sweep (R3G534)	
2	Frame Harness	
2	Door Harness	
2	Position Switch (BM)(see section 28 10 05)	
1	Card Reader/ Keypad (see section 28 10 05)	
1	Power Supply	
Notes: PERIMETER GASKETING SHALL BE PROVIDED BY ALUMINUM DOOR/ FRAME MANUFACTURER.		

HARDWARE SETS		
Set: 1.0 Doors: 100		
<p>Notes: PERIMETER GASKETING SHALL BE PROVIDED BY ALUMINUM DOOR/ FRAME MANUFACTURER</p> <p>Doors normally closed and secured.</p> <p>Presenting valid credential retracts latches on active leaf allowing pull entry. Entry by manual key via turn piece for Fire dept access or during power failure/alarm condition. Depressing either push pad shunts BM and allows for immediate egress. Free egress at all times. System is Fail Secure.</p>		

Set: 2.0 Doors: 101		
2	Continuous Hinge (A31031G)	
2	Push Bar & Pull (J505)	US32D
2	Overhead Stop (C01541)	652
2	Surface Closer (C02021 // C02011)	689
1	Threshold (J32100)	
Notes: PERIMETER GASKETING SHALL BE PROVIDED BY ALUMINUM DOOR/ FRAME MANUFACTURER.		

Set: 3.0 Doors: 111B, 118B		
3	Hinge (A5111)	US32D
1	Exit Device (Type 1, 01)	US32D
1	Surface Closer (C02021)	689
1	Threshold (J36130)	
1	Rain Guard (R0Y976)	

Set: 3.0 Doors: 111B, 118B		
1	Gasketing (R3E164)	
1	Sweep (R3G534)	
Notes: Exit only.		

Set: 4.0 Doors: 137, 138		
6	Hinge (A5111)	US32D
2	Flush Bolt (L04251/L04261)	US26D
1	Storeroom Lock (F07)	US26D
1	Interchangeable Core (E09241)	26
1	Surf Overhead Stop (C02541)	630
1	Surface Closer (C02021)	689
2	Threshold (J36130)	
1	Gasketing (R3E164)	
1	Rain Guard (R0Y976)	
2	Sweep (R3G534)	
2	Astragal (R0E754)	
1	Astragal (R0Y634)	

Set: 5.0		
Not Used		

Set: 6.0 Doors: 127, 135A		
3	Hinge (A5111)	US32D
1	Storeroom Lock (F07)	US26D
1	Interchangeable Core (E09241)	26

1	Electric Strike (E09391	630
1	Surface Closer (C02021)	689
1	Threshold (J36130)	
1	Gasketing (R3E164)	
1	Sweep (R3G534)	
1	Frame Harness	
1	Position Switch (BM)(see section 28 10 05)	
1	Card Reader/ Keypad (see section 28 10 05)	
1	Power Supply (see section 28 10 05)	

Set: 7.0 Doors: 132, 136		
6	Hinge (A5111)	US32D
1	Electric Power Transfer	
1	Flush Bolt (Type 27)	US32D
1	Fail Secure Lock (E01, E06)	US26D
1	Interchangeable Core (E09241)	26
1	Coordinator (Type 21A)	Black
2	Mounting Bracket	US28
1	Surface Closer (C02021)	689
1	Threshold (J36130)	
1	Rain Guard (R0Y976)	
1	Gasketing (R3E164)	
2	Sweep (R3G534)	
2	Astragal (R0E754)	
1	Astragal (R0Y634)	
1	Frame Harness	
1	Door Harness	

Set: 7.0 Doors: 132, 136		
2	Position Switch (BM)(see section 28 10 05)	
1	Card Reader/ Keypad (see section 28 10 05)	
1	Power Supply	

Set: 8.0 Doors: 125, 130B, 131B		
3	Hinge (A8112)	US26D
1	Storeroom Lock (F07)	US26D
1	Interchangeable Core (E09241)	26
1	Surface Closer (C02021 // C02011)	689
1	Door Stop (L02251 / L02121)	US26D

Set: 9.0 Doors: 223		
3	Hinge (A8112)	US26D
1	Surface Closer (C02021 // C02011)	689
1	Classroom Lock (F05)	US26D
1	Interchangeable Core (E09241)	26
1	Kick Plate (J102)	US32D
1	Door Stop (L02251 / L02121)	US26D
1	Adhesive Gasketing (R0E154)	

Set: 10.0 Doors: 111A, 118A, 200, 217		
3	Hinge (A8112)	US26D
1	Exit Device (Type 1, 14)	US32D
1	Surface Closer (C02021 // C02011)	689

Set: 10.0 Doors: 111A, 118A, 200, 217		
1	Door Stop (L02251 / L02121)	US26D
1	Adhesive Gasketing (R0E154)	

Set: 11.0 Doors: 205		
3	Hinge (A8111)	US26D
1	Storeroom Lock (F07)	US26D
1	Interchangeable Core (E09241)	26
1	Electric Strike (E09391)	630
1	Surface Closer (C02021 // C02011)	689
1	Door Stop (L02251 / L02121)	US26D
1	Frame Harness	
1	Position Switch (BM)(see section 28 10 05)	
1	Card Reader/ Keypad (see section 28 10 05)	
1	Power Supply (see section 28 10 05)	

Notes:

STC seals by door supplier.
Door normally closed and locked.
Entry by valid credential energizes electric strike, permits entry and shunts BM.
Entry by manual key alerts system of non-audit trail entry.
Exit permitted at all times and BM is triggered upon each exit.
Electric Strike is Fail Secure.

Set: 12.0 Doors: 219		
3	Hinge (A8112)	US26D

Set: 12.0 Doors: 219		
1	Storeroom Lock (F07)	US26D
1	Interchangeable Core (E09241)	26
1	Electric Strike (E09391)	630
1	Surface Closer (C02021 // C02011)	689
1	Door Stop (L02251 / L02121)	US26D
1	Adhesive Gasketing (R0E154)	
1	Frame Harness	
1	Position Switch (BM)(see section 28 10 05)	
1	Card Reader/ Keypad (see section 28 10 05)	
1	Power Supply (see section 28 10 05)	
<p>Notes:</p> <p>Door normally closed and locked. Entry by valid credential energizes electric strike, permits entry and shunts BM. Entry by manual key alerts system of non-audit trail entry. Exit permitted at all times and BM is triggered upon each exit. Electric Strike is Fail Secure.</p>		

Set: 13.0 Doors: 112, 113, 202, 209, 220		
3	Hinge (A8111)	US26D
1	Classroom Lock (F05)	US26D

Set: 13.0 Doors: 112, 113, 202, 209, 220		
1	Interchangeable Core (E09241)	26
1	Surface Closer (C02021 // C02011)	689
1	Door Stop (L02251 / L02121)	US26D
Notes: STC seals by door supplier.		

Set: 14.0 Doors: 206, 207, 208, 221, 222		
3	Hinge (A8111)	US26D
1	Office Lock (F04)	US26D
1	Interchangeable Core (E09241)	26
1	Surface Closer (C02021 // C02011)	689
1	Door Stop (L02251 / L02121)	US26D
Notes: STC seals by door supplier.		

Set: 15.0 Doors: 218		
3	Hinge (A8111)	US26D
1	Self Latching Flush Bolt (Type 27)	US26D
1	Surface Closer (C02021 // C02011)	689
1	Door Stop (L02251 / L02121)	US26D
Notes: STC seals by door supplier.		

Set: 16.0 Doors: 114				
3	Hinge (A8112)	TA2714 x USA	US26D	MK
1	Passage Set (F01)	8215 LNL	US26D	SA
1	Surface Closer (C02061 / C02051)	PR7500H M / R 7500H M	689	NO
1	Kick Plate (J102)	K1050 10" CSK	US32D	RO
1	Door Stop (L02251 / L02121)	403/470	US26D	RO
1	Adhesive Gasketing (R0E154)	S88		PE

Set: 17.0 Doors: 122, 134		
3	Hinge (A8111)	T4A3786 x USA
1	Storeroom Lock (F07)	US26D
1	Interchangeable Core (E09241)	26
1	Electric Strike (E09391)	630
1	Surface Closer (C02021 // C02011)	689
1	Door Stop (L02251 / L02121)	US26D
1	Threshold (J32100)	
1	Adhesive Gasketing (R0E154)	
1	Sweep (R3B434)	
1	Frame Harness	
1	Position Switch (BM)(see section 28 10 05)	
1	Card Reader/Keypad (see section 28 10 05)	

Set: 17.0 Doors: 122, 134		
1	Power Supply (see section 28 10 05)	
Notes: Door normally closed and locked. Entry by valid credential energizes electric strike, permits entry and shunts BM. Entry by manual key alerts system of non-audit trail entry. Exit permitted at all times and BM is triggered upon each exit. Electric Strike is Fail Secure.		

Set 18.0 Doors: 130A, 131A		
3	Hinge (A5111)	US32D
1	Push Button Cypher Lock	US26D
1	Interchangeable Core (E09241)	26
1	Surface Closer (C02021 // C02011)	689
1	Door Stop (L02251 / L02121)	US26D

Set: 19.0 Doors: 133		
6	Hinge (A8112)	US26D
1	Self Latching Flush Bolt (Type 27)	US32D
1	Dust Proof Strike (L04021)	US26D
1	Classroom Lock (F05)	US26D
1	Interchangeable Core (E09241)	26
1	Surface Closer (C02021 // C02011)	689
2	Door Stop (L02251 / L02121)	US26D
1	Threshold (J32100)	

1	Adhesive Gasketing (R0E154)	
2	Sweep (R3B434)	
1	Astragal (R0Y634)	

Set: 20.0 Doors: 124		
6	Hinge (A8112)	US26D
1	Electric Power Transfer	
1	Self Latching Flush Bolt (Type 27)	US26D
1	Dust Proof Strike (L04021)	US26D
1	Fail Secure Lock (E01, E06)	US26D
1	Interchangeable Core (E09241)	26
1	Surface Closer (C02021 // C02011)	689
2	Door Stop (L02251 / L02121)	US26D
1	Threshold (J32100)	
1	Adhesive Gasketing (R0E154)	
2	Sweep (R3B434)	
1	Astragal (R0Y634)	
1	Frame Harness	
1	Door Harness	
2	Position Switch (BM)(see section 28 10 05)	
1	Card Reader/Keypad (see section 28 10 05)	
1	Power Supply (see section 28 10 05)	

Set:21.0 Doors: 116, 117, 224, 225		
3	Hinge (A8111)	US26D
1	Electric Power Transfer	
1	Fail Safe Electric Lock (E01, E05)	US26D
1	Interchangeable Core (E09241)	26
1	Electric Strike (E09391)	630
1	Automatic Opener	689
1	Restroom Relay Kit	
1	Plate	
2	Wall Switch	
1	Power Supply	
<p>Notes:</p> <p>Door normally closed and unlatched via electric strike w/ indicator light green. Initiating outside wave actuator opens door.</p> <p>Depressing inside "Push to Lock" button energizes electric strike, securing the outside from manual entry, Changes indicator light from green to red and de-energizes outside actuator. Either wave to actuate or manual turn of lever, via RX, resets system and allows for auto operation or manual exit. System is Fail Safe. Power Supply to be located above ceiling within 6 inches on the corridor side.</p>		

Set: 22.0 Doors: 103, 104, 105, 106, 107, 211, 212, 213		
1	Aluminum Top Hung Sliding Door System	Satin Anodized
2	Door Pull	US32D

Set: 22.0 Doors: 103, 104, 105, 106, 107, 211, 212, 213		
Notes:		
Confirm Glass thickness. Provide Sliding Door hardware as detailed on drawings and required to make door function as intended.		
Provide concealed braking system to cushion the opening and closing of the doors.		

Set: 23.0 Doors: 100C, 100D		
3	Hinge (A5111)	US32D
1	Classroom Lock (F05)	US26D
1	Interchangeable Core (E09241)	26
1	Surface Closer (C02021)	689
1	Kick Plate (J102)	US32D
1	Threshold (J36130)	
1	Gasketing (R3E164)	
1	Sweep (R3G534)	

Set: 24.0 Doors: 121		
3	Hinge (A8111)	T4A3786 x USA
1	Storeroom Lock (F07)	US26D
1	Interchangeable Core (E09241)	26
1	Surface Closer (C02021 // C02011)	689
1	Door Stop (L02251 / L02121)	US26D
1	Threshold (J32100)	

Set: 24.0 Doors: 121		
1	Adhesive Gasketing (R0E154)	
1	Sweep (R3G534)	

Set: 25.0 Doors: 109, 110, 128, 215, 216		
3	Hinge (A8112)	US26D
1	Storeroom Lock (F07)	US26D
1	Interchangeable Core (E09241)	26
1	Electric Strike (E09391)	630
1	Surface Closer (C02021 // C02011)	689
1	Door Stop (L02251 / L02121)	US26D
1	Frame Harness	
1	Position Switch (BM)(see section 28 10 05)	
1	Card Reader/ Keypad (see section 28 10 05)	
1	Power Supply (see section 28 10 05)	
Notes: Door normally closed and locked. Entry by valid credential energizes electric strike, permits entry and shunts BM. Entry by manual key alerts system of non-audit trail entry. Exit permitted at all times and BM is triggered upon each exit. Electric Strike is Fail Secure.		

Set: 26.0 Doors: 129		
3	Hinge (A8112)	US26D
1	Storeroom Lock (F07)	US26D

1	Interchangeable Core (E09241)	26
1	Electric Strike (E09391)	630
1	Surface Closer (C02021 // C02011)	689
1	Door Stop (L02251 / L02121)	US26D
1	Threshold (J32100)	
1	Frame Harness	
1	Position Switch (BM)(see section 28 10 05)	
1	Card Reader/ Keypad (see section 28 10 05)	
1	Power Supply (see section 28 10 05)	

Notes:

Door normally closed and locked.
Entry by valid credential energizes electric strike, permits entry and shunts BM.
Entry by manual key alerts system of non-audit trail entry.
Exit permitted at all times and BM is triggered upon each exit.
Electric Strike is Fail Secure.

Set: 27.0 Doors: 100A, 100B, 135B, 135C		
1	Interchangeable Core (E09241)	26
1	Mortise Cylinder (E09251)	US32D
Notes: Cylinder and Core as required. Coordinate w/ Specialty Door supplier.		

-- End of Section --

SECTION 08 81 00

GLAZING
05/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 800 (2016) Voluntary Specifications and Test
Methods for Sealants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (2015) Safety Glazing Materials Used in
Buildings - Safety Performance
Specifications and Methods of Test

ASTM INTERNATIONAL (ASTM)

ASTM C509 (2006; R 2015) Elastomeric Cellular
Preformed Gasket and Sealing Material

ASTM C864 (2005; R 2015) Dense Elastomeric
Compression Seal Gaskets, Setting Blocks,
and Spacers

ASTM C920 (2018) Standard Specification for
Elastomeric Joint Sealants

ASTM C1021 (2008; R 2014) Standard Practice for
Laboratories Engaged in Testing of
Building Sealants

ASTM C1036 (2016) Standard Specification for Flat
Glass

ASTM C1048 (2018) Standard Specification for
Heat-Strengthened and Fully Tempered Flat
Glass

ASTM C1087 (2016) Standard Test Method for
Determining Compatibility of
Liquid-Applied Sealants with Accessories
Used in Structural Glazing Systems

ASTM C1172 (2019) Standard Specification for
Laminated Architectural Flat Glass

ASTM C1184 (2014) Standard Specification for
Structural Silicone Sealants

ASTM C1281	(2016) Standard Specification for Preformed Tape Sealants for Glazing Applications
ASTM D395	(2016; E 2017) Standard Test Methods for Rubber Property - Compression Set
ASTM D2287	(2019) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E1300	(2016) Standard Practice for Determining Load Resistance of Glass in Buildings
ASTM E2190	(2010) Standard Specification for Insulating Glass Unit Performance and Evaluation

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2008) Glazing Manual
GANA Sealant Manual	(2008) Sealant Manual
GANA Standards Manual	(2008) Engineering Standards Manual

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

IGMA TB-1200	(1983; R 2016) Guidelines for Insulating Glass Dimensional Tolerances
IGMA TB-3001	(2001) Guidelines for Sloped Glazing
IGMA TM-3000	(1990; R 2016) North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201	Safety Standard for Architectural Glazing Materials
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Insulating Glass

Glazing Accessories

Sealants

Joint Backer

SD-04 Samples

Insulating Glass

Glazing Compound

Glazing Tape

Sealing Tapes

SD-07 Certificates

Insulating Glass

EPD(s); S

Recycled Content; S

Regional Material; S

SD-08 Manufacturer's Instructions

Setting and Sealing Materials

Glass Setting

SD-11 Closeout Submittals

Warranty for Insulated Glass Units

Warranty for Monolithic Opacified Spandrel

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for glazing.

Provide regional material certifications of applicable materials.

1.2.1.3 IEQ Low-Emitting Materials

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.3 SYSTEM DESCRIPTION

Fabricate and install watertight and airtight glazing systems to withstand

thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, or defects in the work. Glazed panels must comply with the safety standards, in accordance with ANSI Z97.1, and comply with indicated wind/snow loading in accordance with ASTM E1300.

1.3.1 Glazing for Passive Solar and Dynamic Control Fenestration

Identify glazing for Passive Solar and Dynamic Control Fenestration noted as part of a passive solar heating system and/or chromogenic fenestration and evaluate separately from other fenestration. Glazing for use in Passive Solar systems are exempt from SHGC requirements. Area-weighted averaging of chromogenic fenestration with other non-chromogenic fenestration is not permitted. For chromogenic fenestration systems, the lower-rated labeled SHGC must be used with automatic controls to modulate the amount of heat flow into the space in multiple steps in response to daylight levels or solar intensity.

1.4 QUALITY CONTROL

Submit two 8 by 10 inch samples of each of the following: insulating glass units.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, enclosed dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.7 WARRANTY

1.7.1 Warranty for Insulated Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust, fogging, or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 10-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government.

1.7.2 Monolithic Opacified Spandrel

Manufacturer must warrant the opacifier film on the spandrel to be free of peeling for a period of five years after Date of Substantial Completion. Warranty must be signed by manufacturer.

PART 2 PRODUCTS

2.1 GLASS

ASTM C1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.1.1 Clear Glass

Type I, Class 1 (clear), Quality q5 (B). Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 1/8 inch float glass for openings up to and including 15 square feet, 3/16 inch for glazing openings over 15 square feet but not over 30 square feet, and 1/4 inch for glazing openings over 30 square feet but not over 45 square feet.

2.1.2 Annealed Glass

Annealed glass must be Type I transparent flat type, Class 1 - clear, Quality q3 - glazing select, conforming to ASTM C1036.

2.1.3 Laminated Glass

ASTM C1172, Laminated glass fabricated from two nominal 1/8 inch pieces of Type I, Class 1, Quality Q3, flat annealed; clear glass conforming to ASTM C1036. Flat glass to be laminated together with a minimum of 0.030 inch thick, clear polyvinyl butyral laminate, conforming to requirements of 16 CFR 1201 and ASTM C1172. The total thickness of nominally 1/4 inches. Color to be clear.

2.1.4 Mirrors

As specified in 10 28 13, TOILET ACCESSORIES.

2.1.5 Tempered Glass

ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (transparent), Quality q3, conforming to ASTM C1048 and GANA Standards Manual. Color must be clear. Provide wherever safety glazing material is indicated or specified.

2.1.6 Heat-Strengthened Glass

ASTM C1048, Kind HS (heat strengthened), Condition A (uncoated), Type I, Class 1 (clear), Quality q3.

2.1.7 Spandrel Glass

2.1.7.1 Ceramic-Opacified Spandrel Glass

Ceramic-opacified spandrel glass must be Kind HS heat-strengthened transparent flat type, Condition B, coated with a colored ceramic material on No. 2 surface, Quality q3 - glazing select, conforming to ASTM C1048. Color must be as indicated on drawings.

2.2 INSULATING GLASS UNITS

Two panes of glass separated by a dehydrated airspace, filled with argon gas and hermetically sealed, conforming to ASTM E2190. Submit performance

and compliance documentation for each type of insulating glass.

Exterior window assemblies, including glazing, to have a U-Factor and SHGC as noted on drawings.

Dimensional tolerances must be as specified in IGMA TB-1200. Spacer must be black, roll-formed, thermally broken aluminum, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal must be compressed polyisobutylene and the secondary seal must be a specially formulated silicone.

2.2.1 Low Emissivity Coatings (Low-E)

Exterior glass panes for Low-E insulating units must be Type I annealed flat glass, Class 1-clear with anti-reflective low-emissivity coating or heat-strengthened or fully tempered glass complying with ASTM C1048, Condition C on No. 2 surface (inside surface of exterior pane), Quality q3 - glazing select, conforming to ASTM C1036.

2.2.2 Insulated Low-E Laminated (Glazing Type 2A, 2B, 2C)

Outer lite 1/4 inch thick heat-strengthened glazing (or tempered required/indicated) with Low-E coating. Interior lite laminated type. Spandrel located on #4 face where indicated.

Glazing types indicated shall have the following characteristics, as applicable;

Visible Transmittance (VT) - 66 min

Visible Light Reflectance Value (LRV) - 12 max

2.3 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, IGMA TM-3000, IGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted must be gray or neutral color. Sealant testing must be performed by a testing agency qualified according to ASTM C1021.

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified.

2.3.1 Putty and Glazing Compound

Provide glazing compound as recommended by manufacturer for face-glazing metal sash. Putty must be linseed oil type. Do not use putty and glazing compounds with insulating glass or laminated glass.

2.3.2 Glazing Compound

Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

2.3.3 Sealants

Provide elastomeric and structural sealants.

2.3.3.1 Elastomeric Sealant

ASTM C920, Type S, Grade NS, Class 12.5, Use G. Use for channel or stop glazing metal sash. Sealants must be chemically compatible with setting blocks, edge blocks, and sealing tapes, with sealants used in manufacture of insulating glass units. Color of sealant must be white.

2.3.3.2 Structural Sealant

ASTM C1184, Type S.

2.3.4 Joint Backer

Joint backer must have a diameter size at least 25 percent larger than joint width; type and material as recommended in writing by glass and sealant manufacturer.

2.3.5 Glazing Tapes

2.3.5.1 Back-Bedding Mastic Glazing Tapes

Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

- a. AAMA 804.3 tape, where indicated.
- b. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
- c. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.3.5.2 Expanded Cellular Glazing Tapes

Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

- a. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
- b. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.3.6 Sealing Tapes

Preformed, semisolid, PVC-based material of proper size and compressibility for the particular condition, complying with ASTM D2287. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes must be chemically compatible with the product being set.

2.3.7 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks must be dense extruded type conforming

to ASTM C509 and ASTM D395, Method B, Shore A durometer between 70 and 90. Edge blocking must be Shore A durometer of 50 (plus or minus 5). Provide silicone setting blocks when blocks are in contact with silicone sealant. Profiles, lengths and locations must be as required and recommended in writing by glass manufacturer. Block color must be black.

2.3.8 Glazing Gaskets

Glazing gaskets must be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening must be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets must be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Provide glazing gasket profiles as recommended by the manufacturer for the intended application.

2.3.8.1 Fixed Glazing Gaskets

Fixed glazing gaskets must be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C509, Type 2, Option 1.

2.3.8.2 Wedge Glazing Gaskets

Wedge glazing gaskets must be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C864, Option 1, Shore A durometer between 65 and 75.

2.3.8.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing must be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.3.9 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers. Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to surface.

2.3.10 Window Film

Window film (WF-1) to be applied as indicated on drawings. Window film to be applied per manufacturers standards.

2.3.10.1 Window Film Properties

Adhesive Features: Pressure-sensitive
Adhesive Type: Acrylic, Solvent Acrylic
Design Patter: Gradation
Film Thickness: (Imperial)3.7 mil
Film Type: Polyester
Opacity: Translucent
Performance Level: Premium

PART 3 EXECUTION

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

3.1 PREPARATION

Preparation, unless otherwise specified or approved, must conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, must conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place. Verify products are properly installed, connected, and adjusted.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation must conform to applicable recommendations of IGMA TB-3001 and IGMA TM-3000.

3.2.3 Installation of Heat-Absorbing Glass

Provide glass with clean-cut, factory-fabricated edges. Field cutting will not be permitted.

3.2.4 Installation of Laminated Glass

Sashes which are to receive laminated glass must be weeped to the outside to allow water drainage into the channel.

3.3 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass must be clean at the

time the work is accepted.

3.4 PROTECTION

Protect glass work immediately after installation. Identify glazed openings with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Protect reflective glass with a protective material to eliminate any contamination of the reflective coating. Place protective material far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Upon removal, separate protective materials for reuse or recycling. Remove and replace glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities with new units.

-- End of Section --

SECTION 08 91 00

METAL WALL LOUVERS
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 500-L (2015) Laboratory Methods of Testing
Louvers for Rating

AMCA 511 (2010; R 2016) Certified Ratings Program
for Air Control Devices

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2605 (2020) Voluntary Specification,
Performance Requirements and Test
Procedures for Superior Performing Organic
Coatings on Aluminum Extrusions and Panels

ASTM INTERNATIONAL (ASTM)

ASTM B209 (2014) Standard Specification for Aluminum
and Aluminum-Alloy Sheet and Plate

ASTM B221 (2021) Standard Specification for Aluminum
and Aluminum-Alloy Extruded Bars, Rods,
Wire, Profiles, and Tubes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wall Louvers; G

SD-03 Product Data

Metal Wall Louvers; G

SD-04 Samples

Wall Louver Samples; G

SD-07 Certifications

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for louvers.

Provide regional material certifications of applicable materials.

1.3.3 IEQ Low Emitting Materials

For louvers applied inside the weatherproofing system - submit VOC statement indicating compliance with the; a. VOC Emissions Evaluation.

For Adhesives and Sealants applied on site specification section 07 92 00 for low-emitting requirements.

1.4 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers must be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

1.5 DETAIL DRAWINGS

Show all information necessary for fabrication and installation of wall louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

1.6 COLOR SAMPLES

Colors of finishes for wall louver samples must closely approximate colors indicated. Where color is not indicated, submit the manufacturer's standard colors to the Contracting Officer for selection.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Sheet

ASTM B209, alloy 3003 or 5005 with temper as required for forming.

2.1.2 Extruded Aluminum

ASTM B221, alloy 6063-T5 or -T52.

2.2 METAL WALL LOUVERS

Weather resistant type, with bird screens and made to withstand a wind load of not less than 30 pounds per square foot. Wall louvers must bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-L and AMCA 511. The rating must show a water penetration of 0.20 or less ounce per square foot of free area at a free velocity of 800 feet per minute.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.

2.2.2 Screens and Frames

For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers. Provide other accessories as required for complete and proper installation.

2.4 FINISHES

2.4.1 Aluminum

Exposed aluminum surfaces must be factory finished with an organic coating. Louvers for each building must have the same finish.

2.4.1.1 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a superior performance finish in accordance with AAMA 2605 with total dry film thickness of not less than 1.2 mil.

2.4.2 Color

Custom color as indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Copper or Copper-Bearing Alloys

Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.

3.2.2 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.3 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.2.4 Wood

Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

-- End of Section --

SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD

02/10, CHG 2: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A463/A463M	(2015; R 2020; E 2020) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C645	(2014; E 2015) Nonstructural Steel Framing Members
ASTM C754	(2020) Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal Support Systems; G

Submit for the erection of metal. Indicate materials, sizes, thicknesses, and fastenings.

SD-03 Product Data

Metal Support Systems

Recycled Content; S

Regional Material; S

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Sourcing of Raw Materials

Provide recycled content certifications for metal support systems.

Provide regional material certifications for applicable materials.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations permitting easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A653/A653M, G-60; aluminum coating ASTM A463/A463M, T1-25; or a 55-percent aluminum-zinc coating.

Provide metal support systems containing a minimum of 20 percent recycled content. Provide data identifying percentage of recycled content for metal support systems.

2.1.1 Materials for Attachment of Gypsum Wallboard

2.1.1.1 Suspended and Furred Ceiling Systems

ASTM C645.

2.1.1.2 Non-load Bearing Wall Framing and Furring

ASTM C645, but not thinner than 0.0179 inch thickness, with 0.0329 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures.

2.1.1.3 Furring Structural Steel Columns

ASTM C645. Steel (furring) clips and support angles may be provided in lieu of steel studs for erection of gypsum wallboard around structural steel columns.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Systems for Attachment of Gypsum Wallboard

3.1.1.1 Suspended and Furred Ceiling Systems

ASTM C754, except provide framing members 16 inches o.c. unless indicated otherwise.

3.1.1.2 Non-load Bearing Wall Framing and Furring

ASTM C754, except as indicated otherwise.

3.1.1.3 Furring Structural Steel Columns

Install studs or galvanized steel clips and support angles for erection of gypsum wallboard around structural steel columns.

3.2 ERECTION TOLERANCES

Provide framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, within the following limits:

- a. Layout of walls and partitions: 1/4 inch from intended position;
- b. Plates and runners: 1/4 inch in 8 feet from a straight line;
- c. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and
- d. Face of framing members: 1/4 inch in 8 feet from a true plane.

Provide framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

- a. Layout of walls and partitions: 1/4 inch from intended position;
- b. Plates and runners: 1/8 inch in 8 feet from a straight line;
- c. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and
- d. Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

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SECTION 09 29 00

GYPSUM BOARD

08/16, CHG 4: 02/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11 (1992; Reaffirmed 2005) Specifications for
Interior Installation of Cementitious
Backer Units

ASTM INTERNATIONAL (ASTM)

ASTM C475/C475M (2017) Standard Specification for Joint
Compound and Joint Tape for Finishing
Gypsum Board

ASTM C514 (2004; R 2020) Standard Specification for
Nails for the Application of Gypsum Board

ASTM C840 (2020) Standard Specification for
Application and Finishing of Gypsum Board

ASTM C954 (2018) Standard Specification for Steel
Drill Screws for the Application of Gypsum
Panel Products or Metal Plaster Bases to
Steel Studs from 0.033 in. (0.84 mm) to
0.112 in. (2.84 mm) in Thickness

ASTM C1002 (2020) Standard Specification for Steel
Self-Piercing Tapping Screws for the
Application of Gypsum Panel Products or
Metal Plaster Bases to Wood Studs or Steel
Studs

ASTM C1047 (2019) Standard Specification for
Accessories for Gypsum Wallboard and
Gypsum Veneer Base

ASTM C1177/C1177M (2017) Standard Specification for Glass
Mat Gypsum Substrate for Use as Sheathing

ASTM C1396/C1396M (2017) Standard Specification for Gypsum
Board

ASTM C1766 (2015; R2019) Standard Specification for
Factory-Laminated Gypsum Panel Products

ASTM D412 (2016) Standard Test Methods for
Vulcanized Rubber and Thermoplastic

Elastomers - Tension

ASTM D624	(2000; R 2020) Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D3273	(2016) Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
ASTM E90	(2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E336	(2020) Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
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GYPSUM ASSOCIATION (GA)

GA 214	(2010) Recommended Levels of Gypsum Board Finish
GA 216	(2010) Application and Finishing of Gypsum Panel Products
GA 253	(2012) Application of Gypsum Sheathing

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2014) Fire Resistance Directory
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Cementitious Backer Units

Water-Resistant Gypsum Backing Board

Glass Mat Covered or Reinforced Gypsum Sheathing

Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Accessories

Submit for each type of gypsum board and for cementitious backer units.

Gypsum Board

Recycled Content for Gypsum Board; S

Recycled Content for Paper Facing and Gypsum Cores; S

SD-06 Test Reports

ASTM E90 Factory Test Report; G

ASTM E336 Field Test Report; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

Asbestos Free Materials; G

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

SD-08 Manufacturer's Instructions

Safety Data Sheets

SD-10 Operation and Maintenance Data

Manufacturer Maintenance Instructions

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

)Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for gypsum board, paper facing and gypsum cores.

Provide regional material certifications for applicable materials.

1.2.1.3 IEQ Low-Emitting Materials

For Gypsum Board and Panel Materials applied inside the weatherproofing system - submit VOC statement indicating compliance with the:

a. VOC Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Do not store gypsum wallboard with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives. Do not use materials that have visible moisture or biological growth.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

1.5 SCHEDULING

Commence application only after the area scheduled for gypsum board work is completely weathertight. The heating, ventilating, and air-conditioning systems must be complete and in operation prior to application of the gypsum board. If the mechanical system cannot be activated before gypsum board is begun, the gypsum board work may proceed in accordance with an approved plan to maintain the environmental conditions specified below. Apply gypsum board prior to the installation

of finish flooring and acoustic ceiling.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not expose the gypsum board to excessive sunlight prior to gypsum board application. Maintain a continuous uniform temperature of not less than 50 degrees F and not more than 80 degrees F for at least one week prior to the application of gypsum board work, while the gypsum board application is being done, and for at least one week after the gypsum board is set. Shield air supply and distribution devices to prevent any uneven flow of air across the plastered surfaces. Provide ventilation to exhaust moist air to the outside during gypsum board application, set, and until gypsum board jointing is dry. In glazed areas, keep windows open top and bottom or side to side 3 to 4 inches. Reduce openings in cold weather to prevent freezing of joint compound when applied. For enclosed areas lacking natural ventilation, provide temporary mechanical means for ventilation. In unglazed areas subjected to hot, dry winds or temperature differentials from day to night of 20 degrees F or more, screen openings with cheesecloth or similar materials. Avoid rapid drying. During periods of low indoor humidity, provide minimum air circulation following gypsum boarding and until gypsum board jointing complete and is dry.

1.7 FIRE RESISTIVE CONSTRUCTION

Comply with specified fire-rated assemblies for design numbers indicated per UL Fire Resistance or FM APP GUIDE.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only. Submit Safety Data Sheets and manufacturer maintenance instructions for gypsum materials. Provide data identifying VOC emissions of gypsum board and other applicable panel materials.

2.1.1 Gypsum Board

ASTM C1396/C1396M. Gypsum board must contain a minimum of 10 percent post-consumer recycled content, or a minimum of 40 percent post-industrial recycled content. Provide data identifying percentage of recycled content for gypsum board. Paper facings must contain a minimum of 100 percent recycled paper content. Gypsum cores must contain a minimum of 95 percent post-industrial recycled gypsum content. Provide data identifying percentage of recycled content for paper facing and gypsum cores. Provide gypsum wall board and panels meeting the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type).

2.1.1.1 Regular

48 inch wide, 5/8 inch thick, tapered edges.

2.1.1.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

2.1.1.3 Mold Resistant / Anti-Microbial Gypsum

ASTM D3273. 48 inch wide, 5/8 inch thick, tapered edges. Provide at all interior face of exterior walls.

2.1.2 Gypsum Backing Board

ASTM C1396/C1396M, gypsum backing board must be used as a base in a multilayer system.

2.1.2.1 Regular

48 inch wide, 5/8 inch thick, square edges.

2.1.2.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, square edges.

2.1.3 Regular Water-Resistant Gypsum Backing Board

ASTM C1396/C1396M

2.1.3.1 Regular

48 inch wide, 5/8 inch thick, tapered edges.

2.1.3.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

2.1.4 Glass Mat Covered or Reinforced Gypsum Sheathing

Exceeds physical properties of ASTM C1396/C1396M and ASTM C1177/C1177M. Provide 5/8 inch, gypsum sheathing. Provide gypsum board of with a noncombustible water-resistant core, with glass mat surfaces embedded to the gypsum core or reinforcing embedded throughout the gypsum core. Warrant gypsum sheathing board for at least twelve months against delamination due to direct weather exposure. Seal all joints, seams, and penetrations with compatible sealant.

2.1.4.1 Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Provide sealant compatible with glass mat covered or reinforced gypsum sheathing, rubber washers for masonry veneer anchors, and other associated cavity wall components such as anchors and through wall flashing. Provide sealants for glass mat covered or reinforced gypsum sheathing board edge seams and veneer anchor penetrations recommended by the glass mat covered or reinforced gypsum sheathing manufacturer and have the following performance requirements:

- a. ASTM D412: Tensile Strength, 80 psi
- b. ASTM D412: Ultimate Tensile Strength (maximum elongation), 170 psi
- c. ASTM D624: Tear Strength, dieB, 27 ppi
- d. ASTM D1149: Joint Movement Capability after 14 Days cure, plus or minus 50 percent.

2.1.5 Factory-Laminated Gypsum Board

ASTM C1766, regular, 48 inch wide 5/8 inch thick, sound dampening gypsum

panel products composed of two or more factory-laminated gypsum panel laminated into a composite panel. Provide at STC rated partitions.

2.1.5.1 ASTM E90 Factory Test Report

Submit Factory Test Report for proposed STC Rated wall assembly. Test reports must be prepared by an independent acoustical laboratory qualified under the National Voluntary Laboratory Accreditation Program (NVLAP) by the National Institute for Science and Technology (NIST). Test reports must indicate that the sound transmission classification (STC) of the proposed wall assembly, based on tests at 16 third-octave band frequencies from 125 to 4,000 hertz, is no less than STC 50 for STC 45 assemblies and no less than STC 55 for STC 50 assemblies when tested in accordance with ASTM E90.

2.1.6 Cementitious Backer Units

In accordance with the Tile Council of America (TCA) Handbook.

2.1.7 Joint Treatment Materials

ASTM C475/C475M. Product must be low emitting VOC types with VOC limits not exceeding 50 g/L. Provide data identifying VOC emissions and content of joint compound. Use all purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds must be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.

2.1.7.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.7.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.7.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.7.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.7.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.8 Fasteners

2.1.8.1 Nails

ASTM C514.

2.1.8.2 Screws

ASTM C1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2.1.8.3 Staples

No. 16 USS gage flattened galvanized wire staples with 7/16 inch wide crown outside measurement and divergent point for base ply of two-ply gypsum board application. Use as follows:

<u>Length of Legs</u>	<u>Thickness of Gypsum Board</u>
1-1/8 inches	1/2 inch
1-1/4 inches	5/8 inch

2.1.9 Shaftwall Liner Panel

ASTM C1396/C1396M. Conform to the UL Fire Resistance for the Design Numbers(s) indicated for shaftwall liner panels. Manufacture liner panel for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, 1 inch thick, by 24 inch wide.

2.1.10 Accessories

ASTM C1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges must be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.11 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.1.2 Building Construction Materials

Do not install building construction materials that show visual evidence of biological growth.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Minimize framing by floating corners with single studs and drywall clips. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C840, System VIII or GA 216.

3.2.2 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

In dry areas (areas other than tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply glass mat water-resistant gypsum tile backing board or water-resistant gypsum backing board in accordance with ASTM C840, System X or GA 216.

3.2.3 Exterior Application

Apply exterior gypsum board (such as at soffits) in accordance with ASTM C840, System XI or GA 216.

3.2.4 Glass Mat Covered or Fiber Reinforced Gypsum Sheathing

Apply glass mat covered or fiber reinforced gypsum sheathing in accordance to gypsum association publications GA 253. Follow gypsum sheathing manufacturer's requirements of design details for joints and fasteners and be properly installed to protect the substrate from moisture intrusion. Do not leave exposed surfaces of the glass mat covered or fiber reinforced gypsum sheathing beyond the manufacturer's recommendation without a weather barrier cladding. Properly flash the openings. Seal all joints, seams, and penetrations with a compatible silicone sealant.

3.2.5 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C840, System XIII or GA 216. Fill control joints between studs in fire-rated construction with firesafing insulation to match the fire-rating of construction.

3.2.6 Application of Factory-Laminated Gypsum Board

Apply in accordance with manufacturer instructions for testing sound assembly. Face of laminated surface must not be on finished side of assembly.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

3.3.1 Application

In wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply cementitious backer units in accordance with ANSI A108.11. Place a 15 lb asphalt impregnated, continuous felt paper membrane behind cementitious backer units, between backer units and studs or base layer of gypsum board. Place membrane with a minimum 6 inch overlap of sheets laid shingle style.

3.3.2 Joint Treatment

ANSI A108.11.

3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C840, GA 214 and GA 216. Finish plenum areas above ceilings to Level 1 in accordance with GA 214. Finish water resistant gypsum backing board, ASTM C1396/C1396M, to receive ceramic tile to Level 2 in accordance with GA 214. Finish walls and ceilings to receive a heavy-grade wall covering or heavy textured finish before painting to Level 3 in accordance with GA 214. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 5 in accordance with GA 214. Unless otherwise specified, finish all gypsum board walls, partitions and ceilings to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use self-adhering fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust.

3.4.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 JOINT SEALANTS. Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.5.1 Sealing for Glass Mat or Reinforced Gypsum Board Sheathing

Apply silicone sealant in a 3/8 inch bead to all joints and trowel flat. Apply enough of the same sealant to all fasteners penetrating through the glass mat gypsum board surface to completely cover the penetration when troweled flat. Do not place construction and materials behind sheathing until a visual inspection of sealed joints during daylight hours has been completed by Contracting Officer.

3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, wall and ceiling framing in accordance with the specifications contained in UL Fire Resistance for the Design Number(s) indicated. Joints of fire-rated gypsum board enclosures must be closed and sealed in accordance with UL test requirements or GA requirements. Seal penetrations through rated partitions and ceilings tight in accordance with tested systems.

3.7 SOUND RATED ASSEMBLIES

When sound rated assemblies are required, provide materials and application methods, including panels, insulation, types and spacing of fasteners, wall and ceiling framing in accordance with the contract document and the description of the assembly in the ASTM E90 Factory Test Report. Seal partitions continuously with acoustical foam or sealant (both sides) and finished to match wall wherever it abuts another element such as the floor, ceiling, wall, column, mullion, or another system or assembly.

3.8 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

3.9 SHAFTWALL FRAMING

Install the shaftwall system in accordance with the system manufacturer's published instructions. Coordinate bucks, anchors, blocking and other items placed in or behind shaftwall framing with electrical and mechanical work. Patch or replace fireproofing materials which are damaged or removed during shaftwall construction.

3.10 SOUND RATED ASSEMBLY FIELD TESTING

Provide third party testing of sound rated assemblies tested in accordance with ASTM E336. Provide the ASTM E336 Field Test Report verifying that the installed assemblies perform no less than five ASTC rating points below the ASTM E90 Factory Test Report. Examine, modify adjust, and retest any installation not meeting the STC Rating until compliance is obtained.

-- End of Section --

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SECTION 09 30 10

CERAMIC, QUARRY, AND GLASS TILING
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A137.1 (2019) American National Standards
Specifications for Ceramic Tile

ASTM INTERNATIONAL (ASTM)

ASTM C33/C33M (2018) Standard Specification for Concrete
Aggregates

ASTM C144 (2018) Standard Specification for
Aggregate for Masonry Mortar

ASTM C150/C150M (2021) Standard Specification for Portland
Cement

ASTM C1027 (2009; R 2017) Standard Test Method for
Determining Visible Abrasion Resistance of
Glazed Ceramic Tile

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350 (2010; Version 1.1) Standard Method for
the Testing and Evaluation of Volatile
Organic Chemical Emissions from Indoor
Sources using Environmental Chambers

GREEN SEAL (GS)

GS-36 (2013) Adhesives for Commercial Use

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

TILE COUNCIL OF NORTH AMERICA (TCNA)

TCNA Hdbk (2017) Handbook for Ceramic, Glass, and
Stone Tile Installation

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for

Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Porcelain Tile; G

Recycled Content for Porcelain Tile; S

Glazed Ceramic Wall Tile; G

Recycled Content for Glazed Ceramic Wall Tile; S

Transition Strips

Metal Strips

Setting-Bed; G

Mortar, Grout, and Adhesive; G

Reinforcing Wire Fabric

SD-04 Samples

Tile; G

Transition Strips; G

Metal Strips; G

Grout; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

Indoor Air Quality for Adhesives; S

Indoor Air Quality for Sealants; S

SD-08 Manufacturer's Instructions

Manufacturer's Approved Cleaning Instructions

SD-10 Operation and Maintenance Data

Porcelain Tile, Data Package 1; G

Glazed Ceramic Wall Tile, Data Package 1; G

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for tile.

Provide regional material certifications for applicable materials.

1.2.1.3 IEQ Low Emitting Materials (Indoor Air Quality)

For wall treatments systems applied inside the weatherproofing system - submit statement indicating compliance with the;

a. VOC Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.3 QUALITY ASSURANCE

Provide installers having a minimum of two years of experience with a company specializing in performing the type of work described. Each type and color of tile to be provided from a single source. Each type and color of mortar, adhesive, and grout to be provided from the same source.

1.4 DELIVERY, STORAGE, AND HANDLING

Ship tiles in sealed packages and clearly marked with the grade, type of tile, producer identification, and country of origin. Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect materials from weather, and store them under cover in accordance with manufacturer's printed instructions. Store and handle tiles per manufacturer's instructions for gauged porcelain tile and gauged porcelain tile panels/slabs.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50 degrees F and rising. Maintain temperature above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective tiling materials and workmanship, including tile, mortar and grout products and

installation as a system, for a period of one year from date of final acceptance of the work.

1.7 EXTRA MATERIALS

Supply an extra 2 percent of each type tile used in clean and marked cartons.

PART 2 PRODUCTS

2.1 TILE

Provide tiles that comply with ANSI A137.1 and are standard grade tiles. Provide floor tiles with a minimum wet dynamic coefficient of friction (DCOF) value of 0.42 when tested in accordance with ANSI A137.1 requirements. Provide glazed floor tile with a Class V-Heavy Commercial classification as rated by the manufacturer when tested in accordance with ASTM C1027 for visible abrasion resistance as related to foot traffic. For materials like tile, accessories, and transition strips submit samples of sufficient size to show color range, pattern, type and joints.

Submit manufacturers' descriptive product data for each type of tiling indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each type of tiling indicated in drawings.

2.1.1 Porcelain Tile TLP-1

Provide unglazed through body (surface color and pattern go all the way through the tile body), rectified porcelain tile and cove base and trim pieces. Provide tile with a V2 aesthetic classification. Blend tiles in factory and in a packages to have same color range and continuous blend for installation. Provide nominal tile size(s) of 12 by 24 inch and 3/8 inch thick.

Provide porcelain tiling materials that contain a minimum of 10 percent recycled content. Provide data identifying percentage of recycled content for porcelain tile.

2.1.2 Porcelain Mosaic Wall Tile TLP-2

Provide unglazed through body (surface color and pattern go all the way through the tile body). Provide a V3 aesthetic classification. Provide nominal tile size(s) of 1 inch x 2 inch and 3/8 inch thickness. Mosaic tile pattern to be triangular in nature.

2.1.3 Porcelain Tile TLP-3

Provide unglazed through body (surface color and pattern go all the way through the tile body), rectified porcelain tile and cove base and trim pieces. Provide a V3 aesthetic classification. Blend tiles in factory and in packages to have same color range and continuous blend for installation. Provide nominal tile size(s) of 6 inch x 36 inch. 3/8 inch thickness.

2.1.4 Glazed Ceramic Wall Tile TLC-1

Provide glazed, rectified ceramic wall tile that has square edges and trim with lead-free glossy finish. Provide nominal tile size(s) of 2.5 by 10 inch.

Provide glazed ceramic wall tile materials that contain a minimum of 3 percent recycled content. Provide data identifying percentage of recycled content for glazed ceramic wall tile.

2.2 SETTING-BED

Submit manufacturer's catalog data. Compose the setting-bed of the following materials:

2.2.1 Aggregate for Concrete Fill

Conform to ASTM C33/C33M for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.2.2 Portland Cement

Conform to ASTM C150/C150M for cement, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Conform to ASTM C144 for sand.

2.3 WATER

Provide potable water.

2.4 MORTAR, GROUT, AND ADHESIVE

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of GS-36. For products located on the interior of the building (inside of the weatherproofing system, provide certification or validation of indoor air quality for adhesives. Provide bond coat, mortar, and grout supplied from the same manufacturer.

2.4.1 Latex-Portland Cement Mortar

TCNA Hdbk.

2.4.2 Tile Grout GR-1, GR-2, GR-3, GR-4

TCNA Hdbk; Epoxy grout, stain-free and color uniformity. Maximum VOC content of 65 grams/liter. Provide a 1/8 inch grout joint.

2.5 SUBSTRATES

Refer to Section 09 29 00 GYPSUM BOARD.

2.6 MISCELLANEOUS TRIMS

2.6.1 Metal Strips

Provide trim shapes as indicated in the drawings. Provide satin anodized aluminum edging at tile surfaces with exposed outside corners. Provide profiles appropriate for finished wall materials as indicated in the drawings.

2.7 COLOR, TEXTURE, AND PATTERN

Provide color, pattern and texture as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers..

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCNA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	
Dry-Set Mortar	1/8 inch in 8 ft.	
Organic Adhesives	1/8 inch in 8 ft.	
Latex-Portland Cement Mortar	1/8 inch in 8 ft.	
Epoxy	1/8 inch in 8 ft.	

3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Close space, in which tile is being set, to traffic and other work. Keep closed until tile is firmly set. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface. Keep traffic off horizontal portland cement mortar installations for at least 72 hours. Keep all traffic off epoxy installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer. Dimension and draw detail drawings at a minimum scale of 1/4 inch = 1 foot. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface. Submit drawings

showing ceramic tile pattern elevations. Submit manufacturer's preprinted installation instructions.

Do not install building construction materials that show visual evidence of biological growth.

3.3 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCNA Hdbk with grout joints as recommended by the manufacturer for the type of tile.

3.3.1 Workable or Cured Mortar Bed

Install tile over workable mortar bed or a cured mortar bed at the option of the Contractor. Install a 4 mil polyethylene membrane, metal lath, and scratch coat. Conform to TCNA Hdbk for workable mortar bed, materials, and installation of tile. Conform to TCNA Hdbk for cured mortar bed and materials.

3.3.2 Latex-Portland Cement Mortar

Use latex-portland cement to install tile in accordance with TCNA Hdbk. Use latex-portland cement when installing porcelain ceramic tile.

3.3.3 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCNA Hdbk. Provide and apply manufacturer's standard product for sealing grout joints in accordance with manufacturer's recommendations.

3.4 INSTALLATION OF MISCELLANEOUS TRIMS

3.4.1 Metal Trims

Install trim where indicated. Embed anchoring leg in setting mortar in accordance with manufacturer's instructions. During grouting of tile joints, immediately wipe grout from finish surface.

3.5 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

3.5.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

3.6 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen.

Replace damaged or defective tiles.

-- End of Section --

SECTION 09 51 00

ACOUSTICAL CEILINGS
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A489	(2018; E 2018) Standard Specification for Carbon Steel Eyebolts
ASTM A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1008/A1008M	(2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM B633	(2019) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C423	(2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C635/C635M	(2017) Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E413	(2016) Classification for Rating Sound Insulation
ASTM E580/E580M	(2020) Standard Practice for Installation

of Ceiling Suspension Systems for
Acoustical Tile and Lay-in Panels in Areas
Subject to Earthquake Ground Motions

ASTM E795	(2016) Standard Practices for Mounting Test Specimens During Sound Absorption Tests
ASTM E1111/E1111M	(2014) Standard Test Method for Measuring the Interzone Attenuation of Open Office Components
ASTM E1264	(2019) Acoustical Ceiling Products
ASTM E1414/E1414M	(2011a; E 2014) Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
ASTM E1477	(1998a; R 2017; E 2018) Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2019) Structural Engineering
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G

SD-03 Product Data

Acoustical Ceiling Systems; G

Acoustical Performance; G

SD-04 Samples

Acoustical Units; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

FSC Certification For Wood Slatted Ceiling; S

VOC Emissions; S

Formaldehyde Emissions; S

Legal Wood; S

SD-10 Operation and Maintenance Data

Take-Back Program; S

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of ceiling materials including tiles and suspension systems.

Provide Extended Producer Responsibility (EPR/Product Take-Back Programs) data.

Provide regional material certifications for all materials that apply.

Provide FSC certification for wood products.

1.2.1.3 IEQ Low Emitting Materials

For ceiling systems applied inside the weatherproofing system - submit statement indicating compliance with the;

a. VOC Emissions Evaluation

For Composite Wood applied inside the weatherproofing system - submit statement indicating compliance with the;

a. Formaldehyde Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

1.2.1.4 Legal Wood

Submit product data verifying product is from Legal and Responsible Sources per ASTM D7612-10 as required to achieve LEED credit.

1.3 DELIVERY, STORAGE. AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before

installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.4 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.5 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and terrazzo work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship including but not limited to, sagging and warping of panels and rusting and of grid systems, for a period of ten years from date of final acceptance of the work.

1.7 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of 5 tiles for each 1000 tiles installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL CEILING SYSTEMS DESCRIPTION

Provide sound controlling units mechanically mounted on a ceiling suspension system for acoustical treatment. Provide the unit size, texture, finish, and color as specified. The Contractor has the option to substitute inch-pound (I-P) Recessed Light Fixtures (RLF) for metric RLF. If the Contractor opts to provide I-P RLF, then provide I-P products for other ceiling elements like acoustical ceiling tiles, air diffusers, air registers and grills. Coordinate the entire ceiling system with other details, like the location of access panels and ceiling penetrations, for instance, shown on the drawings. The Contractor is responsible for the final assembly and performance of the specified work and products if I-P products are used. Provide the location and extent of acoustical treatment as shown on the approved detail drawings. Submit drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

2.1.1 Acoustical Performance

2.1.1.1 Ceiling Sound Transmission

Provide ceiling systems with the specified Ceiling Attenuation Class (CAC) ratings as determined in accordance with ASTM E1414/E1414M and ASTM E413. Provide sound attenuators over light fixtures, air terminals and other ceiling penetrations, provide acoustical blanket insulation on top of the ceiling or adjacent to partitions to provide lightweight acoustical plenum barriers above partitions as required to achieve the specified CAC

ratings. Provide test ceiling continuous at the partition and assembled in the suspension system in the same manner that the ceiling will be installed on the project.

2.1.1.2 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C423. Determine Articulation Class (AC) in accordance with ASTM E1111/E1111M.

2.1.2 Light Reflectance

Determine light reflectance factor in accordance with ASTM E1477 test method.

2.2 ACOUSTICAL UNITS

Submit samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to ASTM E1264, Class A, and the following requirements:

2.2.1 Units for Exposed-Grid System (ACT-1, typical throughout building unless otherwise noted).

2.2.1.1 Type

IV (non-asbestos mineral fiber with membrane-faced overlay). Provide Type IV Acoustical Ceiling Tiles containing a minimum of 60 percent recycled content. Provide data identifying percentage of recycled content for Type IV ceiling tiles. Provide certification of indoor air quality for Type IV Ceiling Tiles.

2.2.1.2 Flame Spread

Class A, 25 or less

2.2.1.3 Pattern

E

2.2.1.4 Minimum NRC

0.75 when tested on mounting Type E-400 of ASTM E795.

2.2.1.5 Minimum Light Reflectance Coefficient

0.85

2.2.1.6 Nominal Size

24 by 24 inch

2.2.1.7 Edge Detail

Beveled Tegalur

2.2.1.8 Finish

Factory-applied standard finish.

2.2.1.9 Minimum CAC

35

2.2.2 Units for Exposed-Grid System (ACT-2, typical at Main Entrance and Corridors)

2.2.2.1 Type

III (non-asbestos mineral fiber with painted finish). Provide Type III Acoustical Ceiling Tiles containing a minimum of 50 percent recycled content. Provide data identifying percentage of recycled content and certification of indoor air quality for Type III ceiling tiles.

2.2.2.2 Flame Spread

Class A, 25 or less.

2.2.2.3 Pattern

EIK.

2.2.2.4 Minimum NRC

0.65 when tested on mounting Type E-400 of ASTM E795.

2.2.2.5 Minimum Light Reflectance Coefficient

0.85.

2.2.2.6 Nominal Size

24 x 48 inch.

2.2.2.7 Edge Detail

Beveled Tegular.

2.2.2.8 Finish

Factory-applied standard finish with scoring every 6 inches.

2.2.2.9 Minimum CAC

35.

2.2.3 Units for Exposed-Grid System (ACT-3, typical in Open Office Areas)

Large format acoustical ceiling type system with integrated utility channels. Ceiling mounted fixtures, including but not limited to mechanical registers/diffusers, lights and sprinklers must be compatible with integrated ceiling system and fit within channels.

2.2.3.1 Type

IV (non-asbestos mineral fiber with membrane-faced overlay). Provide Type IV Acoustical Ceiling Tiles containing a minimum of 80 percent recycled content. Provide data identifying percentage of recycled content and

certification of indoor air quality for Type IV ceiling tiles.

2.2.3.2 Flame Spread

Class A, 25 or less.

2.2.3.3 Pattern

E.

2.2.3.4 Minimum NRC

0.75 when tested on mounting Type E-400 of ASTM E795.

2.2.3.5 Minimum Light Reflectance Coefficient

0.85

2.2.3.6 Nominal Size

Large Format 30 x 54 inch with 6 inch channels.

2.2.3.7 Edge Detail

Beveled Tegular.

2.2.3.8 Finish

Factory-applied standard finish.

2.2.3.9 Minimum CAC

35.

2.2.4 Units for Wood Slat Ceiling System (WD-1, typical in Conf Rooms)

2.2.4.1 Type

FSC certification for solid popular wood slatted ceiling with black factory finished backer and acoustical infill panels. System must include all trim and accessory pieces necessary for a complete installation. Acoustical infill panels to be individual mounted sound absorbing plaques composed of glass fibers or non-asbestos mineral fibers. Coordinate locations of acoustical infill panels with mechanical ceiling system. Ceiling mounted fixtures, including but not limited to lights must be compatible with wood slatted ceiling system and fit within slats.

2.2.4.2 Flame Spread

ASTM E84 HPVA Fire Classification.

2.2.4.3 Pattern

Wood slats spaced 2.75 inches apart.

2.2.4.4 Minimum NRC (acoustical infill panels)

0.85 when tested on mounting in accordance with ASTM C423 and reported as a 4 frequency average.

2.2.4.5 Minimum Light Reflectance Coefficient

N/A.

2.2.4.6 Nominal Size

12 x 96 x 3.75 inches. Slat width of 1.25 inches (3 slats per panel).

2.2.4.7 Edge Detail

Square

2.2.4.8 Finish

Slats must have a smooth texture and be finished with a popular stain from manuf standard selection. Slat backer to be factory finished black. Acoustical infill panels to be black matte.

2.2.4.9 Minimum CAC (acoustical infill panels)

28.

2.3 SUSPENSION SYSTEM

Provide standard exposed-grid narrow width flange suspension system conforming to ASTM C635/C635M for intermediate-duty systems. Provide surfaces exposed to view of aluminum or steel with a factory-applied white baked-enamel finish. Provide wall molding having a flange of not less than 15/16 inch. Provide standard corners. Provide a suspension system with a maximum deflection of 1/360 of the span length capable of supporting the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Conform seismic details to the guidance in UFC 3-301-01 and ASTM E580/E580M.

For Wood Slat Ceilings (WD-1) provide standard exposed-grid standard width flange suspension system conforming to ASTM C635/C635M for heavy-duty systems. Black backer to be attached to bottom of suspension system.

Provide Suspension System containing a minimum of 15 percent recycled content. Provide data identifying percentage of recycled content for suspension systems.

2.4 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.4.1 Wires

Conform wires to ASTM A641/A641M, Class 1, 0.08 inch (12 gauge) in diameter.

2.4.2 Straps

Provide straps of 1 by 3/16 inch galvanized steel conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B633, Type RS.

2.4.3 Rods

Provide 3/16 inch diameter threaded steel rods, zinc or cadmium coated.

2.4.4 Eyebolts

Provide eyebolts of weldless, forged-carbon-steel, with a straight-shank in accordance with ASTM A489. Provide minimum 1/4 inch, zinc coated eyebolts.

2.5 ACCESS PANELS

Provide access panels that match adjacent acoustical units, designed and equipped with suitable framing and fastenings for removal and replacement without damage. Size panel to be not less than 12 by 12 inch or more than 12 by 24 inch.

- a. Attach an identification plate of 0.032 inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, near one corner on the face of each access panel.
- b. Identify ceiling access panel by a number utilizing white identification plates or plastic buttons with contrasting numerals. Provide plates or buttons of minimum 1 inch diameter and securely attached to one corner of each access unit. Provide a typewritten card framed under glass listing the code identification numbers and corresponding system descriptions listed above. Mount the framed card where directed and furnish a duplicate card to the Contracting Officer. Code identification system is as follows:

- (1) Fire detection/alarm system
- (2) Air conditioning controls
- (3) Plumbing system
- (4) Heating and steam systems
- (5) Air conditioning duct system
- (6) Sprinkler system
- (7) Intercommunication system
- (12) Telephone junction boxes

2.6 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

2.7 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Rid areas, where acoustical units will be cemented, of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Complete and dry interior finish work such as plastering, concrete, and terrazzo work before installation. Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

3.1.1 Suspension System

Install suspension system in accordance with ASTM C636/C636M and as specified herein. Do not suspend hanger wires or other loads from underside of steel decking.

3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

3.1.1.2 Splayed Hangers

Splay (slope or slant) hangers around obstructions, offsetting the resulting horizontal force by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 3 inch from ends of each length and not more than 16 inch on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment. Arrange acoustical units so that units less than one-half width are minimized. Hold units in exposed-grid system in place with

manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

3.1.4 Wood Slat Installation

Install wood slat system according to manufacturer's recommended installation. Backer must be aligned with main beams and cross tees.

3.2 CEILING ACCESS PANELS

Locate ceiling access panels directly under the items which require access.

3.3 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or improperly installed and provide new units as directed.

-- End of Section --

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SECTION 09 65 00

RESILIENT FLOORING
08/10, CHG 3: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4078	(2002; R 2015) Water Emulsion Floor Polish
ASTM F710	(2019; E 2020) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
ASTM F1344	(2015) Rubber Floor Tile
ASTM F1482	(2015) Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
ASTM F1700	(2020) Standard Specification for Solid Vinyl Floor Tile
ASTM F1861	(2016) Standard Specification for Resilient Wall Base
ASTM F1869	(2016a) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F2169	(2015; R 2020; E 2020) Standard Specification for Resilient Stair Treads
ASTM F2170	(2019a) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use
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SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program
For Chemical Emissions For Building
Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Resilient Flooring and Accessories; G

SD-03 Product Data

Resilient Flooring and Accessories; G

Adhesives

Luxury Vinyl Tile; G

Recycled content for Luxury Vinyl Tile; S

Rubber Tile; G

Wall Base; G

Stair Treads, Risers and Stringers; G

SD-04 Samples

Resilient Flooring and Accessories; G

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

Indoor Air Quality for Rubber Tile; S

Indoor Air Quality for Luxury Vinyl Tile; S

Indoor Air Quality for Adhesives; S

SD-08 Manufacturer's Instructions

Surface Preparation

Installation

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for flooring systems.

Provide regional material certifications for applicable materials.

1.2.1.3 IEQ Low Emitting Materials

For Flooring systems - submit statement indicating compliance with the;

a. VOC Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.3 CERTIFICATES

1.3.1 Indoor Air Quality

Submit required indoor air quality certifications and validations in one submittal package.

1.3.1.1 Floor Covering Materials

Provide certified to meet indoor air quality requirements by FLOORSORE, UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification by other third-party programs. Provide current product certification documentation from certification body.

1.3.1.2 Adhesives, Caulking and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or

provide certification or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store exposed rubber surface materials in occupied spaces. Do not store resilient flooring near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.6 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

1.8 EXTRA MATERIALS

Provide extra flooring material of each color and pattern at the rate of 5 tiles for each 1000 tiles and 5 square feet for each 1000 square feet of sheet flooring installed. Provide extra wall base material composed of 20 linear feet of each type, color and pattern. Package all extra materials in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Provide extra materials from the same lot as those installed. Leave extra stock at the site in location assigned by Contracting Officer.

PART 2 PRODUCTS

2.1 RUBBER TILE RF-2

Conform to ASTM F1344 Class 2 layered, Type B (through mottled), 24 inch square. Provide hammered surface studs with chamfered edges. Provide 0.125 inch overall thickness.

Provide certification of indoor air quality for Rubber Tile.

2.2 LUXURY VINYL TILE RF-1

Conform to ASTM F1700 Class III printed film with a minimum wear layer thickness 0.020 inch (20 mil) and minimum overall thickness 0.197 inch, Type B (embossed). Provide 18 inch by 36 inch rectangle tile. Provide tile with a factory protective finish that enhances cleanability and durability.

Provide Luxury Vinyl Tile containing a minimum of 35 percent recycled content. Provide data identifying percentage of recycled content for Luxury Vinyl Tile.

Provide certification of indoor air quality for Luxury Vinyl Tile.

2.3 WALL BASE RB-1

Conform to ASTM F1861, Type TP (thermoplastic rubber), Style A (straight - installed with carpet), and Style B (coved - installed with resilient flooring). Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide job formed corners in matching height, shape, and color.

2.4 STAIR TREADS, RISERS AND STRINGERS RFST-1

Conform to ASTM F2169, Type TS (vulcanized thermoset rubber). Conform to ASTM F2169 for surface of treads Class 2 raised hammered stud pattern and have Group 1 abrasive non-slip strip abrasive material. Provide square nosing. Provide a one piece nosing/tread/riser with a matching coved riser.

2.5 MOULDING

Provide tapered mouldings of vinyl and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 1/4 inch. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

2.6 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer and comply with local indoor air quality standards. Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the

interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.7 SURFACE PREPARATION MATERIALS

Provide surface preparation materials, such as panel type underlayment, lining felt, and floor crack fillers as recommended by the flooring manufacturer for the subfloor conditions. Comply with ASTM F1482 for panel type underlayment products. Use one of the following substrates:

a. Concrete.

2.8 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D4078 for polish.

2.9 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

2.10 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories.

Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern. Submit scaled drawings indicating patterns (including location of patterns and colors) and dimensions. Submit manufacturer's descriptive data and three samples of each indicated color and type of flooring, base, mouldings, and accessories sized a minimum 2-1/2 by 4 inch. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 3 EXECUTION

3.1 EXAMINATION

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation. Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer. Submit manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

3.2 SURFACE PREPARATION

Provide a smooth, true, level plane for surface preparation of the flooring, except where indicated as sloped. Floor to be flat to within 3/16 inch in 10 feet. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Prepare the surfaces of lightweight concrete slabs (as defined by the flooring manufacturer) as recommended by the flooring manufacturer. Comply with ASTM F710 for concrete subfloor preparation. Floor fills or toppings may be required as recommended by the flooring manufacturer. Install underlayments, when required by the flooring manufacturer, in accordance with manufacturer's

recommended printed installation instructions. Comply with ASTM F1482 for panel type underlayments. Before any work under this section is begun, correct all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven surfaces. Repair all damaged portions of concrete slabs as recommended by the flooring manufacturer. Remove concrete curing and sealer compounds from the slabs, other than the type that does not adversely affect adhesion. Remove paint, varnish, oils, release agents, sealers, waxes, and adhesives, as required by the flooring product in accordance with manufacturer's printed installation instructions.

3.3 MOISTURE, ALKALINITY AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F1869 or ASTM F2170, unless otherwise recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

3.4 GENERAL INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

3.5 PLACING LUXURY VINYL TILES

Install luxury vinyl tile flooring using glue down installation. Install flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions for installation method specified. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary edge width as necessary to maintain full-size tiles in the field, no edge tile to be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe edge tile to walls and partitions after field flooring has been applied.

3.6 PLACING RUBBER TILE

Install rubber tile and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Vary width of edge tiles as necessary to maintain full-size tiles, except where irregular-shaped rooms makes it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied.

3.7 PLACING MOULDING

Provide moulding where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials. When required, locate moulding under door centerline. Moulding is not required at doorways where thresholds are provided. Secure moulding with adhesive as recommended by the manufacturer. Prepare and apply adhesives in accordance with manufacturer's printed directions.

3.8 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at masonry walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.9 PLACING STAIR TREADS, RISERS, AND STRINGERS

Secure and install stair treads, risers, and stringers in accordance with manufacturer's printed installation instructions. Cover the surface of treads and risers the full width of the stairs. Provide equal length pieces butted together to cover the treads and risers for stairs wider than manufacturer's standard lengths.

3.10 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry and clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and finish in accordance with manufacturer's written instructions.

3.11 PROTECTION

From the time of installation until acceptance, protect flooring from damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

-- End of Section --

SECTION 09 67 23.13

STANDARD RESINOUS FLOORING

11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C580	(2018) Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C811	(2008) Standard Practice for Surface Preparation of Concrete for Application of Chemical-Resistant Resin Monolithic Surfacing
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D2369	(2010; R 2015; E 2015) Volatile Content of Coatings
ASTM F1869	(2016a) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F2170	(2019a) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meetings

Pre-installation Conference: Conduct conference at Project site.

1.2.2 Product Data

Within 30 days of contract award, submit manufacturer's catalog data for the following items:

- a. Urethane-Resin Binder/Matrix
- b. Cured Epoxy Binder
- c. Aggregate
- d. Urethane Surface Sealing Coat

1.2.3 Design Mix Data

Within 30 days of contract award, submit design mix data for the following items, including a complete list of ingredients and admixtures:

- a. Urethane-Resin Binder/Matrix
- b. Cured Epoxy Binder
- c. Urethane Surface Sealing Coat

Ensure applicable test reports verify the mix has been successfully tested and meets design requirements.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings

SD-03 Product Data

Manufacturer's Catalog Data; G

SD-04 Samples

Hardboard Mounted Epoxy Flooring; G

Floor Topping; G

SD-05 Design Data

Design Mix Data; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

Listing of Product Installations

Referenced Standards Certificates

SD-11 Closeout Submittals

Warranty; G

1.4 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.4.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.4.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for flooring systems.

Provide regional material certifications for applicable materials.

1.4.3 IEQ Low Emitting Materials

For Flooring systems applied inside the weatherproofing system - submit statement indicating compliance with the;

a. VOC Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect materials from weather, soil, and damage during delivery, storage, and construction. Deliver materials in original packages, containers, or bundles bearing brand name and name of material.

Maintain materials used in the installation of floor topping at a temperature between 65 and 85 degrees F.

1.6 QUALITY CONTROL

Prior to commencement of work, submit referenced standards certificates for the following, showing conformance with the referenced standards contained in this section:

a. Urethane-Resin Binder/Matrix

b. Cured Epoxy Binder

c. Aggregate

d. Urethane Surface Sealing Coat

1.6.1 Qualifications

Submit a listing of product installations for 5mm thick decorative flake urethane flooring including identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. Identify purchaser, address of installation, service organization, and date of installation.

Ensure floor system applicators are experienced in the application of troweled aggregate thin-set floor topping.

1.6.2 Sampling

Submit hardboard mounted epoxy flooring samples not less than 12 inch square for each required color.

Provide panels showing nominal thickness of finished toppings, color, and texture of finished surfaces. Finished floor toppings and the approved samples are to match in color and texture.

1.7 WARRANTY

Submit a 2 year written warranty for all materials and installation work.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Submit installation drawings for heavy duty epoxy flooring systems clearly designating the areas of application and the installation plan. Include in the installation plan, methods to control sand and dust if sand blasting is required. System components to be from a single manufacturer.

2.1.1 RESINOUS FLOORING (EF-2)

3/16 inch flake broadcast flooring system.

a. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. Primer

(a) Material Basis: Urethane Primer.

(b) Resin: Urethane.

(c) Formulation Description: (2) two component, low viscosity, urethane.

(d) Application Method: Squeegee and nap roller.

(e) Number of Coats: (1) one.

2. Body Coat(s)

(a) Resin: Urethane 100% Solids.

(b) Formulation Description: (4) four components.

- (c) Application Method: Screed and Metal Trowel.
1) Thickness of Coats: 1/8 inch / 3mm, with primer coat.
2) Number of Coats: (1) one.

3. Undercoat:

- (a) Resin: High-solids, epoxy bonding coat.

(b) Formulation Description: (2) two component high-solids, epoxy bonding coat. A colored coat that accepts the flakes

(c) Application Method: Squeegee and medium nap roller.

(d) Number of Coats: (1) One

4. Broadcast:

- (a) Material Basis:

(b) Formulation Description: Decorative flake (1/16 inch).

(c) Type: Tweed (chips to be mixed in Mfg. facility).

(d) Number of Coats: (1)One.

5. Topcoat:

- (a) Resin: Aliphatic polyaspartic.

(b) Formulation Description: (2) two component, UV resistant, aliphatic polyaspartic urethane.

(c) Type: Clear.

(d) Finish: Gloss.

(e) Number of Coats: (2) two.

Tensile Strength (ASTM D638)	1,000 psi
Flexural Strength (ASTM C580)	2,000 psi
Flexural Modulus of Elasticity (ASTM D790)	1.1 x 106 psi
Hardness (ASTM D2240, Shore D)	80
VOC Content (ASTM D2369, Method E)	Urethane Mortar - 11 g/l TRF Undercoat - 30 g/l Stonseal CA7 - 100 g/l

PART 3 EXECUTION

3.1 PREPARATION

Prior to applying resinous flooring material, inspect substrate and immediately report any unsatisfactory conditions that exist and repair.

Verify that the concrete substrates are dry and the moisture-vapor emissions are within acceptable levels according to the manufacturer's written instructions.

Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with application of resinous flooring only after substrates have a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.

Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

Alkalinity and Adhesion Testing: Verify that concrete substrates have a pH within an acceptable range. Perform tests recommended by the manufacturer. Proceed with the application only after the substrates pass testing.

3.1.1 Safety Precautions

Prior to application in confined spaces of toppings and coatings containing flammable or toxic properties, institute safety precautions recommended by the manufacturer of the product.

Erect "NO SMOKING" signs, and prohibit smoking or use of spark- or flame-producing devices within 50 feet of any mixing or placing operation involving flammable materials.

Provide the personnel required to handle, mix, or apply toppings containing toxic or flammable properties with such items of personal protective equipment and apparel for eye, skin, and respiratory protection as are recommended by the manufacturer of the product. Ensure all personnel are trained in the appropriate use and wearing of personal protection equipment.

3.1.2 Protection of Adjacent Surfaces

In addition to the protection of adjacent surfaces during installation, provide areas used to store and mix materials with a protective covering under the materials. After application of the sealer coats, protect finished flooring during the remainder of the construction period. In areas of expected minimum or moderate traffic, cover floors with 70 pound kraft paper, with strips taped together and edges secured to prevent roll-up. Place vegetable fiberboard, plywood, or other suitable material that does not mar the flooring over the paper to protect areas used as passages by workmen and areas subject to floor damage because of subsequent building operations. Upon completion of construction, remove the protection, clean flooring and, where necessary, repair, reseal, or both, at no additional cost to the Government.

3.1.3 Concrete Subfloor

3.1.3.1 New Concrete Floors

Do not commence installation of the floor topping until the concrete has cured a minimum of 28 calendar days. Verify that the concrete floor is straight, properly sloped, and has rough type finish. Ensure that the concrete is moist cured with burlap or polyethylene. Do not use curing agents, methods, or materials which prevent proper bonding of resinous flooring. Mechanically prepare substrate with the use of diamond grinding equipment or shot-blast. Comply with ASTM C811 requirements unless manufacturer's written instructions are more stringent. Before applying the prime coat, clean the concrete surface by an approved method.

3.1.4 Mixing Of Materials

Select the job mix proportions on the trial batch proportions used to prepare the floor topping samples as submitted and approved. Binder aggregate ratio normally range from 1:2 to 1:2.3 (by weight), since mixtures providing satisfactory density, trowelability, and surface texture are affected by variations in particle shapes, sizes, and size distribution. Blend three different walnut shell aggregate gradations (by weight) as follows: 1 part No. 1; 1.15 parts No. 2; and 1.15 parts No. 3. Minor adjustments of the mix proportions of the approved floor topping samples are permitted, subject to approval.

Use mechanical equipment for mixing of materials in accordance with the manufacturer's instructions.

Use rotating paddle-type masonry mortar mixers for preblending the three sizes and color pigment, if any, of the walnut shell aggregate and addition of the mixed epoxy resin binder. Ensure mixing times are as recommended by the materials supplier(s), provided mixing times result in homogeneous mixtures. Limit quantity of material mixed at one time to that which can be applied and finished within the working life of the mixtures. Verify that the temperature of materials at the time of mixing are between 65 and 85 degrees F.

3.2 APPLICATION

3.2.1 Areas of Application

Anchor plates set with the top surface at or above the finished epoxy floor level do not require coverage with this flooring material. Extend flooring under equipment, except when the equipment base is indicated to be flush against the structural floor. Cover and/or mask surfaces not to receive the epoxy floor topping, such as equipment or cabinets installed prior to surface-preparation efforts and adjacent to the flooring installation.

3.2.2 Application of Prime Coat and Troweling

Combine the binder components A and B in the proportions specified by the manufacturer to form a clear compatible system immediately on mixing. Cure combined components to a clear film possessing a glossy, non-greasy surface at relative humidities less than 80 percent, having the following properties after curing 24 hours at 77 degrees F, followed by 24 hours at 125 degrees F:

Ensure that the prepared subfloor surface is dry and at a temperature of not less than 60 degrees F when application of the floor topping is initiated. Immediately before application of the prime/scratch coat on the prepared surface, remove dust or other loose particles by blowing with compressed air or vacuum cleaned. Use only an air compressor equipped with an efficient oil-water trap to prevent oil contamination or wetting of surface.

Apply a thin roller coat of the urethane primer specified to the prepared subfloor as a prime coat. As an aid to placing, compacting, and finishing the floor topping, form a scratch coat by sprinkling a minimum quantity of the walnut shell aggregate on the prime coat surface immediately following the prime coat application. Prior to application of the prime/scratch coat, fill cracks in the concrete per manufacturer's instructions, and make provisions to keep control or expansion joints open.

Place the floor topping prior to final gelling of the prime/scratch coat. Immediately after the materials are mixed as specified, dump the mixture in the placement area and spread to prolong troweling life. Screed or rough trowel placed materials to the specified thickness and then compact by the use of a smooth roller prior to finish troweling to a nominal thickness of 3/16 inch plus or minus 1/16 inch. Ensure all finished surfaces are free of ridges, hollows (bird-baths), trowel marks, and smoothness varies no more than 1/8 inch when tested with an 8 foot straightedge. Make provisions to maintain the work areas in a relatively dust-free environment during curing of the topping.

3.2.3 Sealer Coat

After the floor topping has set firmly (approximately 6 to 16 hours depending on subfloor temperature) in a relatively dust-free environment, apply two thin coats of the sealer coat, by means of brush, roller, squeegee, or notched trowel to provide a pore-free, easy-to-clean surface. At the time of sealer application, ensure that the surface is dust-free. Depending on relative humidity, allow the applied sealer to cure to a tack-free condition in 2 to 4 hours. Do not apply second coat until after the initial coat has cured to a tack-free, hard film. Maintain topping areas in a relatively dust-free environment during curing of the sealer coats.

3.2.4 Integral Cove Base

Provide a 4 inch high cove base to all wall surfaces as indicated on the drawings. Install so as to provide a 1/2 inch radius at the juncture of the floor and the wall.

3.3 FIELD QUALITY CONTROL

3.3.1 Repairing

Remove and replace damaged or unacceptable portions of completed work with new work to match adjacent surfaces at no additional cost to the Government.

3.4 ADJUSTING AND CLEANING

Clean surfaces of the new work, and adjacent surfaces soiled as a result of the work. Remove all equipment, surplus materials, and rubbish associated with the work from the site.

-- End of Section --

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SECTION 09 67 23.15

FUEL RESISTIVE RESINOUS FLOORING, 3-COAT SYSTEM
02/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C679	(2015) Tack-Free Time of Elastomeric Sealants
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D1308	(2002; R 2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D3925	(2002; R 2015) Sampling Liquid Paints and Related Pigmented Coatings
ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D6237	(2019) Standard Guide for Painting Inspectors (Concrete and Masonry Substrates)

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 310.2R	(2013) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair
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MASTER PAINTERS INSTITUTE (MPI)

MPI 211	(2018) Floor Coating, Primer, Thin Film, for Aircraft Maintenance Facilities
MPI 212	(2018) Floor Coating, Thin Film, for Aircraft Maintenance Facilities

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC QP 5	(2012) Standard Procedure for Evaluating the Qualifications of Coating and Lining Inspection Companies
SSPC QP 8	(2015) Standard Procedure for Evaluating the Qualifications of Contracting Firms that Install Polymer Coatings, Surfacing, Linings or FRP Composites on Concrete and Other Cementitious Substrates
SSPC QS 1	(2015) Standard Procedure for Evaluating a Contractor's Advanced Quality Management System
SSPC-TU 2/NACE 6G197	(1997) Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection
29 CFR 1910.1000	Air Contaminants
29 CFR 1926.59	Hazard Communication

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Joint Sealant; G

Thin Film Flooring System; G

White Aluminum Oxide Non-Skid Grit; G

SD-05, Design Data

Environmental Control System

SD-06 Test Reports

Joint Sealant Test Report; G

Primer Coat; G

Urethane Topcoat; G

Patch Test Demonstration; G

Daily Inspection Report; G

Adhesion Testing; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

Coating Work Plan; G

Joint Sealant Certificates; G

Thin Film Flooring System Certificates; G

Qualifications of Certified Industrial Hygienist (CIH)

Qualifications of Certified Protective Coatings Specialist (PCS)

Qualifications of Coating Inspection Company

Qualifications of QC Specialist Coating Inspector

Qualifications of Coating Contractors; G

Warranty; G

SD-08 Manufacturer's Instructions

Joint Sealant Manufacturer's Instructions; G

Thin Film Flooring System Manufacturer's Instructions; G

Water-Based Alkaline Degreaser; G

SD-11 Closeout Submittals

Inspection Logbook; G

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for flooring systems.

Provide regional material certifications for applicable materials.

1.3.3 IEQ Low Emitting Materials

For Flooring systems applied inside the weatherproofing system - submit statement indicating compliance with the;

a. VOC Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

For Paints and Coatings applied on site refer to specification section 09 90 00 for low-emitting requirements.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications of Certified Protective Coatings Specialist (PCS)

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party PCS. Submit documentation that the specialist is certified by SSPC: The Society for Protective Coatings (SSPC) as a PCS, including certification number and date of certification/recertification. If the PCS is employed by the same coating inspection company to which the coating inspector is employed, this does not violate the independent third-party requirements. The PCS must remain certified during the entire project, and the Contracting Officer must be notified of any change in certification status within 10 days of the change. The PCS must not be the designated coating inspector.

1.4.2 Coating Work Plan

- a. Include Coating Work Plan in Quality Control Plan.
- b. Provide procedures for reviewing Contract Documents immediately after award to identify errors, omissions, and discrepancies so that any such issues can be resolved prior to project planning and development of detailed procedures.
- c. Provide procedures for verification of key processes during Initial Phase to ensure that Contract requirements can be met. Key processes must include surface preparation, coating application and curing, inspection, and documentation, and any other process that might adversely impact orderly progression of work.
- d. Provide procedures for all phases of coating operations, including planned work, rework, repair, inspection, and documentation. Address mobilization and setup, surface preparation, coating application, coating initial cure, tracking and correction of non-compliant work, and demobilization. Coordinate work processes with health and safety plans and confined space entry plans. For each process, provide procedures that include appropriate work instructions, material and equipment requirements, personnel qualifications, controls, and process verification procedures. Provide procedures for inspecting work to verify and document compliance with Contract requirements, including inspection forms and checklists, and acceptance and rejection criteria.
- e. Provide procedures for correcting non-compliant work. Detailed procedures are required in advance to avoid delays in meeting overcoat windows as well as to avoid delays in production. Provide procedures

for repairing defects in the coating film, such as runs, drips, sags, holidays, overspray, as well as how to correct coating thickness non-compliance, any other areas of repair or rework that might be adversely affected by delays in preparing and approving new procedures.

- f. If a procedure is based on a proposed or approved request for deviation, the deviation must be referenced. Changes to procedures must be noted by submittal number and date approved, clearly delineating old requirements and new requirements, so that the records provide a continuous log of requirements and procedures.

1.4.3 Design Data

1.4.3.1 Environmental Control System

Submit design details of the proposed environmental control system to include ventilation, humidity control, and temperature regulation. Provide calculations for humidity control during separate surface preparation and coating application procedures, ventilation requirements during coating application, and maximum allowable coating application rates to coincide with ventilation. Include basis of design data on local conditions. Provide equipment layout sketches and procedures showing function of each piece of equipment and fail-safe measures. A Certified Industrial Hygienist must approve calculations, work procedures and personal protective equipment.

1.4.4 Test Reports

1.4.4.1 Joint Sealant Test Report

Submit test results that confirm sealant complies with the requirements of Table Ia. Samples must have been tested within the last three years.

1.4.4.2 Daily Inspection Report

Submit one copy of the daily inspection report to the Contracting Officer within 24 hours of the date recorded.

1.4.5 Certificates

1.4.5.1 Qualifications of Certified Industrial Hygienist (CIH)

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party CIH. Submit documentation that hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification. Provide evidence of experience with hazards involved in industrial coating application work.

1.4.5.2 Qualifications of Coating Inspection Company

Submit documentation that the coating inspection company performing all coating inspection functions is certified by SSPC to the requirements of SSPC QP 5 prior to Contract award. The coating inspection company submitted and approved must remain and not changed through completion of the Contract. The coating inspection company must remain so certified for the duration of the project. If a coating inspection company's certification expires, the firm will not be allowed to perform any inspection functions, and all surface preparation and coating application

work must stop, until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Notify the Contracting Officer of any change in coating inspection company certification status. Notify the Contracting Officer of all scheduled and unannounced on-site inspections from SSPC and furnish a copy of all inspection reports.

1.4.5.3 Qualifications of QC Specialist Coating Inspector

Submit documentation that each coating inspector is employed, and qualified to SSPC QP 5, Level II, by the selected coating inspection company. Each inspector must remain employed by the coating inspection company while performing any coating inspection functions. In addition to the handwritten records, the inspector must employ an electronic reporting program with functionality as outlined in Table II. The Administrator must be the designated Government Representative for the project.

1.4.5.4 Qualifications of Coating Contractors

All Contractors that perform surface preparation or coating application must be certified to SSPC QP 8 and should also be SSPC QS 1 certified prior to Contract award and must remain certified while accomplishing any surface preparation or coating application. The painting Contractors must remain so certified for the duration of the project. If a Contractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Notify the Contracting Officer of any change in Contractor certification status. Notify the Contracting Officer of all scheduled and unannounced on-site audits from SSPC and furnish a copy of all audit reports.

Minimum requirements for the installation Contractor are as follows: Completed three or more jobs within the past two years applying the specified materials to concrete surfaces in which the total area exceeds 200,000 square feet. Submit documentation listing location of work, point of contact at job site, total square footage of applied materials, listing of both materials and equipment used, and validation from coating manufacturer documenting quality of materials purchased per job for work totaling 200,000 square feet within the past two years. In addition to the above requirements, be certified by the material manufacturer(s) to install the submitted coatings and sealant. Submit copy of certificates.

1.4.5.5 Joint Sealant Certificates

Submit literature documenting the past performance of the sealant's use in automotive or aircraft maintenance shops. Minimum requirements are two or more maintenance shops with joint work totaling 10,000 linear feet where the sealant has performed for two years with less than 1 percent combined sealant failures and defects. List location of shops, total linear feet of sealant applied per shop, shop point of contact, date sealant was applied, and the name of the installed sealant material.

1.4.5.6 Thin Film Flooring System Certificates

Provide manufacturer's certification of conformance to Contract requirements.

Submit literature documenting the past performance of the coating system's

use in aircraft maintenance shops and over floors with high rates of Moisture Vapor Emission (MVE). Minimum requirements are two or more aircraft maintenance shops totaling 34,000 square feet where the coating system has performed for two years with less than 0.05 percent combined premature coating failures, material defects and surface discoloration; no more than 0.03 percent discoloration from aviation chemicals, tire plasticizers, and UV exposure. Provide a minimum of two additional case histories where successful installation occurred on floor slabs with no less than 3.5 pounds moisture per 24 hours, 1000 square feet. List location of shops, total coated area per shop, shop point of contact, date coating system was applied, successful installation to concrete with high MVE, and the names of the installed coating materials.

1.4.6 Product Data

1.4.6.1 Joint Sealant Manufacturer's Instructions

Submit manufacturer's printed instructions to include detailed application procedures, minimum and maximum application temperatures, and curing procedures. In accordance with 29 CFR 1926.59, include Safety Data Sheets (SDS) for the sealant to be used at the job site.

1.4.6.2 Thin Film Flooring System Manufacturer's Instructions

Submit manufacturer's printed instructions to include detailed mixing, minimum and maximum application temperatures, acceptable atmospheric and interior climatic conditions, application procedures, curing procedures, and procedures for maintenance cleaning of flooring system. Provide explicit instructions detailing surface preparation, recoat windows and remedial actions in case recoat windows are missed, and, if applicable, solvent-wiping between coats with acceptable types and grades of solvents. In accordance with 29 CFR 1926.59, include SDSs for the coatings to be used at the job site.

1.4.6.3 Water-Based Alkaline Degreaser

Submit manufacturer's printed instructions to include detailed mixing, rate of dilution, application procedures, and rinsing procedures. In accordance with 29 CFR 1926.59, include SDSs for the water-based alkaline degreaser to be used at this job site.

1.5 DELIVERY, STORAGE, AND HANDLING

Store coatings and sealant in spaces with temperatures from 40 degrees F to 75 degrees F. Inspect materials on site for damage prior to use. Return to manufacturer packaged materials in dented, rusty, or leaking containers. Conduct testing by manufacture of returned materials with an expired shelf life and if compliant, reissue a shelf life extension.

1.6 COATING HAZARDS

Ensure that employees are trained in all aspects of the safety plan. Follow the coating manufacturer's written safety precautions throughout mixing, application, and curing of coatings. Comply with respiratory protection requirements in 29 CFR 1910.134 and safe levels of airborne contaminants in 29 CFR 1910.1000.

1.7 JOB SITE REFERENCES

Make available to the Contracting Officer at least one copy each of ASTM D4541, ASTM D6237, SSPC-TU 2/NACE 6G197, and ICRI 310.2R, including replica standards ICRI 310.2R CSP 1 through CSP 9, at the job site.

1.8 PATCH TEST DEMONSTRATION

Prior to the submitted flooring system's approval, apply the complete coating system to a 10 foot by 10 foot square section of concrete as prepared in accordance with PART 3 EXECUTION. Within this area, perform three adhesion tests as described in the paragraph ADHESION TESTING. If adhesion testing produces cohesive failures within the concrete, no less than 40 mils concrete removed over 95 percent of each pull-off coupon, or adhesion more than 400 psi, patch test adhesion is acceptable. If concrete surface preparation was insufficient, apply an additional coating system patch to properly prepared concrete followed by the above adhesion testing. If adhesion results are unacceptable for both the topcoats and the primer, submit a new coating system manufactured by a different coating vendor. Apply a patch of the new coating system and subject patch to the above requirements for adhesion prior to approval. If customer is not satisfied with the non-skid grit application, adjustments to the specifications can be made. Grit coarser than No. 60 aluminum oxide is not recommended.

1.9 WARRANTY

Warranty materials and workmanship for a minimum period of one year following coating and sealant application. The following terms and conditions form a part of the warranty: If the applied coating system develops either blisters (chemical), checks, softening, or lifting within one year following application, rework each area at Contractor's expense. The following conditions are excluded from the warranty: A) concrete cracking, flooring system mirrors cracks in concrete; B) cosmetic imperfections due to scratching and gouging; C) application to metallic concrete finishes; and D) application to concrete with a rate of Moisture Vapor Emission (MVE) greater than 3.5 pounds moisture per 24 hours, 1000 square feet. If the coating system's adhesion is in question, perform one adhesion test per 100 square feet as described in the paragraph ADHESION TESTING. To satisfy the warranty, each adhesion test must produce cohesive failures, concrete removal over 95 percent of each pull-off coupon, or adhesion no less than 400 psi. Require two additional adhesion tests to confirm results for each area failing to meet adhesion requirements. Within the warranty period, remove to sound material and rework all areas unable to meet adhesion requirements. There must be zero percent sealant failures within one year. Within the warranty period, remove and rework all sealant material with chemically attacked surfaces or lifting from joint walls. Topcoat cracking over sealant is excluded from warranty.

PART 2 PRODUCTS EF-1

2.1 BASIS OF DESIGN

2.1.1 System Characteristics

1. Color and Pattern: As indicated in the drawings.
2. Wearing Surface: Standard smooth

3. Integral Cove Base: 4 inch integral base on all walls indicated in the drawings.

4. Overall System Thickness: nominal 1/4 inch

2.1.2 System Components

1. Primer:

- a. a. Material Basis: Standard Primer.
- b. Resin: Epoxy.
- c. Formulation Description: (2) two component, 100 percent solids.
- d. Application Method: Squeegee and roller.
- e. Number of Coats: (1) one.

2. Mortar Base:

- a. Resin: Epoxy.
- b. Formulation Description: (3) three component, 100 percent solids.
- c. Application Method: Metal Trowel.
 - 1) Thickness of Coats: nominal 1/4 inch (6.4 mm).
 - 2) Number of Coats: One.
- d. Aggregates: Pigmented Blended aggregate.

3. Top Coat:

- a. Resin: Epoxy.
- b. Formulation Description: (2) two component 100 percent solids.
- c. Type: pigmented.
- d. Finish: standard
- e. Number of Coats: (1) one.

2.2 THIN FILM FLOORING SYSTEM

A three-coat industrial flooring system consisting of primer and two urethane topcoats. Apply the coating system at a Dry Film Thickness (DFT) ranging from 13 to 20 mils and contain a broadcast of aluminum oxide non-skid grit.

2.2.1 Primer Coat

In addition to the requirements of the thin film flooring system, use MPI 211 primer coat.

2.2.2 Urethane Topcoat

In addition to the requirements of the thin film flooring system, use MPI 212 top coat.

PART 3 EXECUTION

3.1 COATING SAMPLE COLLECTION

The Contracting Officer and QC Manager must witness all material sampling. Notify the Contracting Officer a minimum of three days in advance of sampling. Obtain liquid samples of each component of primer

and topcoat by random selection from sealed containers and in accordance with ASTM D3925. Samples may be either individual cans of liquid material or 1.0 quart quantities of properly mixed, extracted, and sealed liquid material. Identify samples by designated name, specification number, batch number, project Contract number, sample date, intended use, and quantity involved. When the applied coating system has met the requirements defined in the paragraph ADHESION TESTING, return coating to the installation Contractor for proper disposal.

3.2 DEGREASING

On both coated and uncoated concrete, degrease entire floor by scrubbing using a solution of hot potable water, 120 degrees F to 170 degrees F, and a concentrated water-based alkaline degreaser. Perform two complete degreasing cycles on the entire floor surface. Allow solution to soak into surfaces prior to scrubbing and remove using hot potable water under a minimum of 4,000 psi. Rinsing is complete when the rinse water appears clear. If the industrial detergent is not biodegradable, collect all rinse water and dispose as hazardous waste. Squeegees and shop vacuums may be used to collect pooling rinse water. Fans may be used to aid drying of floor surfaces.

3.3 SURFACE PREPARATION

Shot blast entire floor to produce a level of coarseness equal to ICRI 310.2R CSP 3. Overlap each pass of shot blasting by 1/4 inches to 1/2 inches. Add new shot to shot blasting equipment prior to blasting. Prepare surfaces inaccessible to shot blasting, base of perimeter walls and under secured equipment, using diamond disk grinding or light scarification to produce a level of coarseness equal to ICRI 310.2R CSP 2 or ICRI 310.2R CSP 4, respectively. Resulting surfaces must appear clean and contain the appropriate level of surface coarseness. If the resulting level of cleanliness cannot be determined, place numerous drops of water on surfaces that appear contaminated. If the water drops soak into concrete, the surfaces are free of hydrocarbon contamination (oils, grease, skydrol). If the water drops bead up and do not flatten out, surfaces require additional degreasing as detailed in the Article DEGREASING. Shot blasting coarse concrete or broom finished concrete can produce a level of coarseness equal to ICRI 310.2R CSP 5: employ a best-effort attempt to minimize over-shot-blasting of coarse concrete. If coarse concrete is encountered, shot blasting to a level of coarseness equal to ICRI 310.2R CSP 5 is acceptable: however, extremely coarse concrete can require resurfacing prior to the flooring system's installation. Sweep, vacuum, and run a high powered magnet over all surfaces to be coated, including joints.

3.4 JOINT TREATMENT

Use the "Conventional Sealed Joint" as detailed in Figure 1 of SSPC-TU 2/NACE 6G197 to seal joints. Employ measures to reduce contamination from equipment and foot traffic. Limit floor access to essential Contractor personnel. Confirm joint surfaces are sufficiently clean.

3.4.1 Install Backer Rod

Install a continuous length of round, closed-cell polyethylene backer rod into each joint using a backer rod tool. For 1/2 inch, 3/8 inch, and 1/4 inch wide joints, place backer rod to a depth of 3/8 inch (depth equals

the distance from the concrete's surface to the highest point on the backer rod). For joints greater than or equal to 3/4 inch width, place backer to a depth of 5/8 inch below the concrete's surface. Fit backer rod tight between joint walls (30 percent compression). Remove and reinstall all backer rod that is installed using either the incorrect size (loose fit) or at the incorrect depth. Following backer rod installation, apply painter's tape to surfaces adjacent joints to protect from sealant.

3.4.2 Joint Sealant Application

Apply sealant directly into joints using a bulk-caulking gun. At room temperature, the resulting sealant application must exhibit a concave recess between 1/8 inch to 1/16 inch below the concrete's surface. Remove and reapply cured sealant remaining either flush or greater. Following sealant application, remove painter's tape and sealant drips on concrete surfaces. Cure sealant a minimum of 24 hours, prior to the application of coatings.

3.5 PRE-APPLICATION TESTING FOR CONTAMINATION

Spot check surfaces for oil/grease contamination using the water break test. At a rate of 5 tests per 1000 square feet, place one to two drops of water onto surfaces and observe for beading. Test all other surfaces that show visible signs of potential contamination. Apply additional degreasing techniques to surfaces displaying water beading in accordance with the Article DEGREASING.

3.6 COATING APPLICATION

Vacuum flooring space one additional time prior to coating application.

3.6.1 Primer Application

Apply MPI 211 epoxy primer to flooring space at 7.0 mils to 15.0 mils Dry Film Thickness (DFT). If the prepared concrete resembles an ICRI 310.2R CSP 3 surface, apply the primer at a minimum of 7.0 mils DFT. If the prepared concrete resembles an ICRI 310.2R CSP 5 surface, apply the primer at a maximum of 15.0 mils DFT. The previously applied sealant may be lightly coated.

3.6.2 Non-Skid Grit Broadcast

Broadcast non-skid grit at a rate of 1.5 pounds per 100 square feet into the second urethane top coat and backroll. Map floor into 600 square foot sections where 9.0 pounds of non-skid grit is pre-weighed, placed into clean buckets and used in its entirety per marked 600 square foot section.

3.6.3 Application of Topcoats

Apply two coats of MPI 211 epoxy urethane topcoat to the epoxy primer and broadcast white aluminum oxide non-skid grit directly into the second urethane topcoat.

3.6.3.1 First Topcoat

Apply a full coat of the urethane topcoat at a spreading rate from 2.5 to 3.2 mils Dry Film Thickness (DFT). Stripe coat perimeter edges and around equipment footings. Monitor and record a minimum of one Wet Film Thickness (WFT) reading per 600 square feet of floor surface. Sealant is

to be lightly coated.

3.6.3.2 Second Topcoat

Apply a second coat of the urethane topcoat at a spreading rate of 2.5 to 3.2 mils DFT. Stripe coat perimeter edges and around equipment footings. Monitor and record a minimum of one WFT reading per 600 square feet of floor surface prior to broadcasting non-skid grit. When the correct WFT has been applied per 600 square feet of area, immediately and evenly broadcast non-skid grit directly into the second topcoat of urethane and backroll in two directions. Test the adhesion of the thin film flooring system in accordance with the paragraph ADHESION TESTING.

3.7 CURING

Cure installed materials to display performance equal to manufacturer's product literature. Remove and reapply improperly cured material.

3.8 FIELD QUALITY CONTROL

3.8.1 Coating Inspector

Consider the Coating Inspector as a QC Specialist, who works for the QC Manager, and qualified in accordance with Section 01 45 00.00 10 01 45 00.00 20 01 45 00.00 40 QUALITY CONTROL. The Coating Inspector must be present during all field tests, surface preparation, flooring application, initial cure of the flooring system, and during all flooring repair work. The Coating Inspector must provide all tools/equipment necessary to perform field tests and inspection. The Coating Inspector is responsible for field tests and specified level of inspection.

3.8.2 Inspection

Document weather conditions, job site occurrences, and report conditions and occurrences potentially detrimental to the flooring system. The listed inspection requirements are in addition to the QC inspection and reporting requirements defined in Section 01 45 00.00 10 01 45 00.00 20 01 45 00.00 40 QUALITY CONTROL. The Coating Inspector must prepare a project reference sheet outlining all requirements, tests, test methods, and evaluation criteria, and hold regular meetings with Contractor personnel, including shot blasting operators and applicators, to review requirements/evaluation criteria for upcoming work prior to execution. At the start of coating operations and every hour following until daily work is complete, record air temperature, substrate temperature, and relative humidity. Following the application of each coat, inspect surfaces for improperly cured material, blisters, inadequate or excessive coating thickness, and other defects. Document each inspection, test, non-compliant area, and location of each non-compliant area. List method of evaluation, evaluation criteria, areas requiring rework, and all other pertinent observations.

3.8.2.1 Daily Inspection Report

Submit to the Contracting Officer one copy of the daily inspection report completed each day when performing work under this Section. Use Appendix X1 "Inspection Checklist" of ASTM D6237 to monitor daily activity and to assist in preparing the daily inspection report. Note each non-compliant issue and each issue identified for rework in accordance with the QC documentation procedures of Section 01 45 00.00 10 01 45 00.00 20

01 45 00.00 40 QUALITY CONTROL. Use of forms containing entry blocks for all required data is encouraged. The data must be legible and presented in a professional format. Submit report within 24 hours of the report date.

3.8.2.2 Inspection Logbook

Maintain a continuous record of all activity related to this Section on a daily basis. A computer / software package as outlined in Table II is preferred to record all information provided in the Daily Inspection Reports, as well as other pertinent observations and information including photo documentation where appropriate. The designated Government Representative for the project is assigned the highest level Administrator privileges and only the Administrator must be able to modify reports. In areas where photography is not allowed, the computer must come with verification that the camera / photo capability has been removed.

Alternatively, a continuous record of all activity related to this Section must be maintained in an Inspection Logbook on a daily basis. The logbook must be hard or spiral bound with consecutively numbered pages, and must be used to record all information provided in the Daily Inspection Reports, as well as other pertinent observations and information. Submit the original Inspection Logbook to the Contracting Officer upon completion of the project and prior to final payment.

3.8.2.3 Inspection Equipment

Use equipment in good condition, operational within its design range, and calibrated as required by the specified standard for use with each device.

3.8.3 Adhesion Testing

Perform a minimum of three adhesion tests in accordance with ASTM D4541 to the thin film flooring system. Select three random flooring locations spaced a minimum of 20 feet between each location. Prior to attaching pull-off coupons, lightly sand flooring surface and attach pull-off coupons containing a grit-blasted anchor profile. Adhere directly to the center of each sanded surface a 3/4 inch diameter pull-off coupon. When pull-off coupon adhesive has sufficiently cured, score circumference of each pull-off coupon to concrete substrate. Test adhesion and evaluate results. If testing produces cohesive failures within the concrete, no less than 40 mils concrete removed over 95 percent of each pull-off coupon, or adhesion more than 400 psi coating system's adhesion is acceptable. If the above requirements are not satisfied, then perform one adhesion test per 100 square feet using the above procedures. Perform two additional tests per non-compliant area to confirm results. Remove to sound material and rework all areas unable to meet adhesion requirements. Repair each adhesion test using a combination of primer, sand-filled epoxy mortar (for deep cohesive failures, if applicable), and two urethane topcoats. Make repairs flush with adjacent coatings and display an equivalent appearance.

3.9 FINAL CLEANUP

Following completion of the work, remove debris, equipment, and materials from the site. Remove temporary connections to Government or Contractor furnished water and electrical services. Restore existing facilities in and around the work areas to their original condition.

TABLE I - MATERIALS REQUIREMENTS	
TABLE Ia	
Test	Minimum Requirement (maximum where indicated)
Sealant System (two-pack: self-leveling)	Polysulfide (Manganese Cure; MnO ₂) or Urethane
Percent Volume Solids	100 percent
Chemical Resistance to JP-8 plus 100 Fuel at 70 degrees F (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Chemical Resistance to Motor Oils at 70 degrees F (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Chemical Resistance to Skydrols at 70 degrees F (ASTM D1308) (see note 1)	48 hours immersion: 2.0 percent (max) weight increase, 5.0 percent (max) volume increase, 2.0 percent (max) weight loss
Hardness (ASTM D2240: Shore A)	20
Tensile Strength (ASTM D412) (or ASTM D638)	150 psi
Percent Elongation (ASTM D412) (or ASTM D638)	500 percent
Tack Free at 65 degrees F (ASTM C679)	12 hours maximum
Adhesion to Concrete	140 psi
Adhesion to Urethane Topcoats (paintable sealant)	140 psi
NOTES: (1) Immerse and test a minimum of three 2 inch by 1/2 inch by 1/2 inch section of cured sealant.	

TABLE II
Reporting Program Requirements QA/QC
Administrative Controls:
Administrators must be able to turn on and off unique access to specific jobs and Contracts.
Administrators must be able to remotely enable and disable access for users.
All enabled users must view the same active report in real time. There must be no opportunity for multiple versions of the same report to exist.
Administrators must be able to setup unique approval processes for each project and promote or remove unique people from this process at any time.
Administrators must be able to associate Contract specific documents and specification limits quickly and easily.
Administrators must be able to associate PDS, SDS, blueprints, scope of work and Contracts uniquely to each job.
Objectivity Controls:
Data Entry fields must be by multi-selectable choices, numeric keypads, pickers and skip logic to ensure repeatable data entry in a way that makes running analytics and metrics easy and objective.
The program / hardware package must be able to communicate with inspection devices that provide (batch) data export capability such as Elcometer and Defelsko gages.
The program / hardware package must automatically time, date and GPS stamp all reports without input or interference from the inspector.
Real Time Syncing:
Forms must be available for approved associates to view at all times.
Retrievable storage must be provided for all job related reports and documents for a minimum time of 5 years from completion of the job or project. Archiving of the documents after 5 years will be the responsibility of the Government.
Document Library:
All reports must be in searchable and annotatable PDF format.
The Administrator must be able to upload and annotate job specific reports in real time. Examples include but not limited to Safety Data Sheets, Product Data Sheets and Blueprints.

TABLE II
Annotations and modifications must be locked and associated with the document. Only the Administrator has rights to modify or delete annotations or allow modifications to the document library especially all related inspection reports.
Customization:
The program must be capable of being customized to specific jobs, Contracts or specifications.

-- End of Section --

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SECTION 09 68 00

CARPETING

11/17, CHG 2: 08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 16	(2004; E 2008; E 2010) Colorfastness to Light
AATCC 107	(2013) Colorfastness to Water
AATCC 165	(2013) Colorfastness to Crocking: Textile Floor Coverings - Crockmeter Method

ASTM INTERNATIONAL (ASTM)

ASTM D1335	(2017; E 2018) Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
ASTM D2859	(2016) Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
ASTM D3278	(1996; R 2011) Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D5793	(2018) Standard Test Method for Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings
ASTM D5848	(2020) Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings
ASTM D6859	(2011) Standard Test Method for Pile Thickness of Finished Level Pile Yarn Floor Coverings
ASTM D7330	(2015) Standard Test Method for Assessment of Surface Appearance Change in Pile Floor Coverings Using Standard Reference Scales
ASTM E648	(2019a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CARPET AND RUG INSTITUTE (CRI)

CRI 104	(2015) Carpet Installation Standard for
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Commercial Carpet

CRI 105 (2015) Carpet Installation Standard for
Residential Carpet

CRI Test Method 103 (2015) Standard Test Method for the
Evaluation of Texture Appearance Retention
of Carpet Standards Program

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2551 (2020) Textile Floor Coverings and Textile
Floor Coverings in Tile Form-
Determination of Dimensional Changes Due
to the Effects of Varied Water and Heat
Conditions and Distortion Out of Plane

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1630 Standard for the Surface Flammability of
Carpets and Rugs (FF 1-70)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S"
classification. Submittals not having a "G" or "S" classification are for
Contractor Quality Control approval. Submit the following in accordance
with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Carpet; G

Recycled Content for Carpeting; S

Moldings; G

SD-04 Samples

Carpet; G

Moldings

SD-06 Test Reports

Moisture and Alkalinity Tests

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

Indoor Air Quality for Carpet; S

SD-08 Manufacturer's Instructions

Surface Preparation

SD-10 Operation and Maintenance Data

Cleaning and Protection

Maintenance Service

Take-Back Program; S

SD-11 Closeout Submittals

Warranty

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications of carpet materials.

Provide regional material certifications for all materials that apply.

1.2.1.3 IEQ Low Emitting Materials

For Flooring systems applied - submit statement indicating compliance with the;

a. VOC Emissions Evaluation.

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Remove materials from packaging and store them in a clean, dry, well ventilated area (100 percent outside air supply, minimum of 1.5 air changes per hour, and no recirculation), protected from damage, soiling, and moisture, and strong contaminant sources and residues, and maintain at a temperature above 60 degrees F for 2 days prior to installation. Do not store carpet or carpet tiles with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants, including paints and adhesives. Do not store carpet near materials that may off gas or emit harmful fumes, such as

kerosene heaters, fresh paint, or adhesives.

1.4 AMBIENT CONDITIONS

Maintain areas in which carpeting is to be installed at a temperature above 60 degrees F and below 90 degrees F for 2 days before installation, during installation, and for 2 days after installation. Provide temporary ventilation during work of this section. Maintain a minimum temperature of 55 degrees F thereafter for the duration of the contract.

1.5 WARRANTY

Provide manufacturer's standard performance guarantees or warranties including minimum ten year wear warranty, two year material and workmanship and ten year tuft bind and delamination.

PART 2 PRODUCTS

2.1 CARPET

Furnish first quality carpet that is free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Provide carpet materials and treatments as reasonably nonallergenic and free of other recognized health hazards. Provide a static control construction on all grade carpets which gives adequate durability and performance. Submit manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory. Submit manufacturer's Product Data for 1) Carpet, 2) Moldings. Also, submit Samples of the following:

- a. Carpet: Two "Production Quality" samples 18 by 18 inches of each carpet proposed for use, showing quality, pattern, and color specified

2.1.1 Recycled Content

Carpeting must contain a minimum of 20 percent recycled content. Provide data identifying percentage of recycled content for carpeting.

2.1.2 Indoor Air Quality Requirements

Products must meet emissions requirements as required per LEED. Provide certification or validation of indoor air quality for carpet.

2.1.3 Physical Characteristics for Modular Tile Carpet CPT-1 and CPT-2

2.1.3.1 Carpet Construction

Tufted

2.1.3.2 Type

Modular tile 48 by 12 inch with 0.15 percent growth/shrink rate in accordance with ISO 2551.

2.1.3.3 Pile Type

Multilevel loop

2.1.3.4 Pile Fiber

Commercial 100 percent branded (federally registered trademark) nylon continuous filament.

2.1.3.5 Gauge or Pitch

Minimum 1/10th inch in accordance with ASTM D5793

2.1.3.6 Stitches or Rows/Wires

Minimum 8.5 per square inch

2.1.3.7 Surface Pile Weight

Minimum 23 ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D5848.

2.1.3.8 Pile Thickness

Minimum .263 inch in accordance with ASTM D6859

2.1.3.9 Pile Density

Minimum 9,409

2.1.3.10 Dye Method

Solution dyed

2.1.3.11 Backing Materials

Provide primary backing materials like synthetic material. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet.

2.1.4 Physical Characteristics for Modular Tile Carpet CPT-3 and CPT-4

2.1.4.1 Carpet Construction

Tufted

2.1.4.2 Type

Modular tile 18 by 36 inch

2.1.4.3 Pile Type

Patterned loop

2.1.4.4 Pile Fiber

Type 6, 6 Nylon

2.1.4.5 Gauge or Pitch

5/64

2.1.4.6 Stitches or Rows/Wires

10.5/11

2.1.4.7 Surface Pile Weight

19/21

2.1.4.8 Pile Thickness

.092 inch

2.1.4.9 Pile Density

Minimum 7,434

2.1.4.10 Dye Method

Solution dyed

2.1.4.11 Backing Materials

Provide primary backing materials like synthetic material. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet.

2.2 PERFORMANCE REQUIREMENTS

2.2.1 Texture Appearance Retention Rating (TARR)

Provide carpet with a greater than or equal to 3.5 (Severe) TARR traffic level classification in accordance with ASTM D7330 or CRI Test Method 103.

2.2.2 Flammability and Critical Radiant Flux Requirements

Comply with 16 CFR 1630 or ASTM D2859. Provide carpet in corridors and exits with a minimum average critical radiant flux of 0.45 watts per square centimeter when tested in accordance with ASTM E648.

2.2.3 Tuft Bind

Comply with ASTM D1335 for tuft bind force required to pull a tuft or loop free from carpet backing with a minimum 8 pound average force for modular carpet tile.

2.2.4 Colorfastness to Crocking

Comply dry and wet crocking with AATCC 165 and with a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.

2.2.5 Colorfastness to Light

Comply colorfastness to light with AATCC 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and with a minimum 4 grey scale rating after 40 hours.

2.2.6 Colorfastness to Water

Comply colorfastness to water with AATCC 107 and with a minimum 4.0 gray

scale rating and a minimum 4.0 transfer scale rating.

2.2.7 Delamination Strength

Provide delamination strength for tufted carpet with a secondary back of minimum 2.5 lbs/inch.

2.3 ADHESIVES AND CONCRETE PRIMER

Comply with applicable regulations regarding toxic and hazardous materials. Provide water resistant, mildew resistant, nonflammable, and nonstaining adhesives and concrete primers for carpet installation as required by the carpet manufacturer. Provide release adhesive for modular tile carpet as recommended by the carpet manufacturer. Provide adhesives flashpoint of minimum 140 degrees F in accordance with ASTM D3278.

2.4 MOLDINGS

Provide carpet moldings where floor covering material changes or carpet edge does not abut a vertical surface. Provide a heavy-duty rubber molding designed for the type of carpet being installed. Provide floor flange of a minimum 1 1/2 inches wide.

2.5 COLOR, TEXTURE, AND PATTERN

Provide color, texture, and pattern in accordance with the drawings.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Do not install carpet on surfaces that are unsuitable and will prevent a proper installation. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Repair holes, cracks, depressions, or rough areas using material recommended by the carpet or adhesive manufacturer. Free floor of any foreign materials and sweep clean. Before beginning work, test subfloor with glue and carpet to determine "open time" and bond. Submit three copies of the manufacturer's printed Installation instructions for the carpet, including Surface Preparation, seaming techniques, and recommended adhesives and tapes.

3.2 MOISTURE AND ALKALINITY TESTS

Test concrete slab for moisture content and excessive alkalinity in accordance with CRI 104/CRI 105. Submit three copies of reports of Moisture and Alkalinity Tests including content of concrete slab stating date of test, person conducting the test, and the area tested.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Do not commence installation of the carpeting until concrete substrate is at least 90 days old. Prepare the concrete surfaces in accordance with the carpet manufacturer's instructions. Match carpet, when required, and adhesives to prevent off-gassing to a type of curing compounds, leveling agents, and concrete sealer.

3.4 INSTALLATION

Isolate area of installation from rest of building. Perform all work by

manufacturer's approved installers. Conduct installation in accordance with the manufacturer's printed instructions and CRI 104/CRI 105. Protect edges of carpet meeting hard surface flooring with molding and install in accordance with the molding manufacturer's printed instructions. Follow ventilation, personal protection, and other safety precautions recommended by the adhesive manufacturer. Continue ventilation during installation and for at least 72 hours following installation. Do not permit traffic or movement of furniture or equipment in carpeted area for 24 hours after installation. Complete other work which would damage the carpet prior to installation of carpet. Submit three copies of Installation Drawings for 1) Carpet, and 3) Moldings indicating areas receiving carpet, carpet types, patterns, direction of pile, location of seams, and locations of edge molding.

Do not install building construction materials that show visual evidence of biological growth.

3.4.1 Modular Tile Installation

Install modular tiles with vinyl-compatible adhesive and snug joints.

3.5 CLEANING AND PROTECTION

Submit three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

3.5.1 Cleaning

As specified in Section 01 78 00 CLOSEOUT SUBMITTALS. After installation of the carpet, remove debris, scraps, and other foreign matter. Remove soiled spots and adhesive from the face of the carpet with appropriate spot remover. Cut off and remove protruding face yarn. Vacuum carpet clean with a high-efficiency particulate air (HEPA) filtration vacuum.

3.5.2 Protection

Protect the installed carpet from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Lap and secure edges of kraft paper protection to provide a continuous cover. Restrict traffic for at least 48 hours. Remove protective covering when directed by the Contracting Officer.

3.6 REMNANTS

Manage waste as specified in the Waste Management Plan. Provide remnants remaining from the installation, consisting of scrap pieces more than 2 feet in dimension with more than 6 square feet total as directed by the Government. Set aside and return non-retained scraps to manufacturer for recycling into new product.

3.7 MAINTENANCE

3.7.1 Extra Materials

Provide extra material from same dye lot consisting of uncut carpet tiles for future maintenance. Provide a minimum of three percent of total square yards of each carpet type, pattern, and color.

3.7.2 Maintenance Service

Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Service must reclaim materials for recycling and/or reuse. Service must not landfill or burn reclaimed materials. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation of manufacturer's take-back program for carpet. Include contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and reuse.

Reference 01 33 29 for LEED take-back requirements.

-- End of Section --

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SECTION 09 72 00

WALLCOVERINGS
08/17, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E84 (2020) Standard Test Method for Surface Burning Characteristics of Building Materials

GYPSUM ASSOCIATION (GA)

GA 214 (2010) Recommended Levels of Gypsum Board Finish

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 286 (2019) Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS CCC-W-408 (Rev D; Notices 1, 2) Wallcovering, Vinyl Coated

UNDERWRITERS LABORATORIES (UL)

UL 723 (2021) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Wallcoverings and Accessories; G

Primer and Adhesive

SD-04 Samples

Wallcoverings and Accessories; G

SD-07 Certificates

EPD; S

Recycled Content; S

Regional Material; S

VOC Emissions; S

SD-08 Manufacturer's Instructions

Wallcoverings and Accessories

SD-10 Operation and Maintenance Data

Wallcoverings and Accessories

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for wall coverings.

Provide regional material certifications for applicable materials.

1.3.3 IEQ Low-Emitting Materials

For wall coverings applied inside the weatherproofing system - submit VOC statement indicating compliance with the;

a. VOC Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver the material to the site in manufacturer's original wrappings and packages and clearly label with the manufacturer's name, brand name, pattern and color name and number, dye lot number, size, and other related information. Store in a safe, dry, clean, and well-ventilated area at temperatures not less than 50 degrees F and within a relative humidity range of 30 to 60 percent. Store wallcovering material in a flat position and protected from damage, soiling, and moisture. Do not open containers until needed for installation, unless verification inspection is required.

1.5 ENVIRONMENTAL REQUIREMENTS

Comply with wallcovering manufacturer's printed installation instructions

for minimum temperature of area to receive requirements for conditioning adhesive and wallcovering. Provide a minimum 50 degrees F area temperature, 72 hours prior to installation, during installation, and until the adhesive dries. Observe ventilation and safety procedures.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one-year period.

1.7 EXTRA MATERIALS

Provide one linear foot of full-width wallcovering of each pattern and color for each 100 linear feet of wallcovering installed. Provide the same manufacturer, type, pattern, color, and lot number of extra stock as the installed wallcovering. Provide full rolls, packed for storage and marked with content, manufacturer's name, pattern and color name and number and dye lot number. Leave extra stock at the site at a location as directed by the Contracting Officer.

PART 2 PRODUCTS

2.1 WALLCOVERINGS AND ACCESSORIES

Provide wall coverings and accessories material designed specifically for the specified use. Provide vinyl wallcovering and borders with a mercury, cadmium, lead, and chromium free base. Protect wallcoverings with bactericides and mildew inhibitors against microbiological and mildew growth.

2.1.1 Product Data

- a. Wallcovering: Submit manufacturer's descriptive data, documenting physical characteristics, flame resistance, mildew and germicidal characteristics for wallcovering.
- b. Accessories: Submit manufacturer's descriptive data for corner guard and wainscot cap.
- c. Primer and Adhesive: Submit manufacturer's descriptive data, documenting physical characteristics, mildew and germicidal characteristics.

2.1.2 Samples

2.1.2.1 Wallcovering

Submit three samples of each indicated type, pattern, and color of wallcovering. Provide minimum 5 by 7 inch samples of wallcovering to show pattern repeat of sufficient size.

2.1.2.2 Wallcovering

Provide three samples, 3 yards long by the width specified, of each type to be installed in the work, as required to illustrate material weight, color, shade, decorative design, and embossing when required.

2.1.3 Certificates

Submit manufacturer's statement attesting that the product furnished meets or exceeds specification requirements. Date the statement after the award of the contract, state Contractor's name and address, name the project and location, and list the requirements being certified. Include these certificates:

- (1) Certified laboratory test reports of the physical properties for vinyl wallcovering, as specified.
- (2) Certificates of Compliance for UL fire hazard classification listing, as specified.
- (3) Certificates of Compliance for contact adhesive.

2.1.4 Manufacturer's Instructions

Submit preprinted installation instructions for wallcovering and accessories, adhesives and primers. Include substrate preparation and material application in the instructions.

2.1.5 Operations and Maintenance Data

- a. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.
- b. Submit three copies of manufacturer's maintenance instructions for each type of vinyl wallcovering and accessory describing recommended type of cleaning equipment and materials, spotting and cleaning methods, and cleaning cycles. Instructions to also include preventative maintenance, recommended cleaning materials and precautions in the use of cleaning materials that may be detrimental to the wallcovering surface and accessories when improperly applied.

2.2 VINYL WALLCOVERING (WG-1, WG-2), (WG-3)

Provide a vinyl coated woven or nonwoven wallcovering fabric. Conform to FS CCC-W-408 for vinyl wallcovering, Type II (Medium Duty) with a minimum total weight of 13 ounces/square yard and 20 ounces/linear yard. Provide width of 52/54 inch. Test vinyl wallcovering in accordance with NFPA 286 or meet the requirements of Class A when tested in accordance with ASTM E84 or UL 723.

Provide Vinyl Wallcovering containing a minimum of 10 percent recycled content. Provide data identifying percentage of recycled content for vinyl wallcovering.

Provide certification of indoor air quality for vinyl wallcovering.

2.3 PRIMER AND ADHESIVE

Provide a type primer and adhesive recommended by the wallcovering manufacturer, containing a non-mercury based mildewcide, and complying with local indoor air quality standards. Primer must permit removal of the wallcovering and protect the wall surface during removal. Do not damage gypsum wallboard facing paper during removal of wallcovering. Provide a strippable type adhesive. When substrate color variations show through vinyl wallcovering, provide a white pigmented primer as

recommended by the wallcovering manufacturer used to conceal the variations. Provide a recommended type adhesive to install corner guards and wainscot cap by the manufacturer of the corner guards and wainscot cap.

2.4 COLOR, TEXTURE, AND PATTERN

Provide custom digital wall graphic as indicated in the drawings. Wall graphic listed is not intended to limit the selection of equal graphic options from other manufacturers.

PART 3 EXECUTION

3.1 EXAMINATION

Inspect all areas and conditions under which wallcoverings are to be installed. Notify the Contracting Officer, in writing, of any conditions detrimental to the proper and timely completion of the installation. Work will proceed only when conditions have been corrected and accepted by the installer.

3.2 SURFACE PREPARATION

Do not apply wallcovering to surfaces that are rough, that contain stains which will bleed through the wallcovering, or that are otherwise unsuitable for proper installation. Fill cracks and holes; sand rough spots smooth. Finish walls to receive presentation dry erase wallcovering to a Level 4 gypsum wallboard finish in accordance with GA 214 unless Level 5 is recommended by the wallcovering manufacturer. Thoroughly dry surfaces at least 30 days prior to installation of vinyl wallcovering. Provide interior surfaces of new and existing gypsum wallboard with a wallcovering primer in accordance with the manufacturer's printed instructions. As required, use white primer when substrate color variations are visible through thin or light color wallcovering. Seal interior surfaces of exterior masonry walls to prevent moisture penetration, then prime with a wallcovering primer in accordance with the manufacturer's printed instructions. Provide masonry walls with flush joints. Test moisture content of plaster, concrete, and masonry with an electric moisture meter of a maximum five percent reading. Apply a thin coat of joint compound or cement plaster, as recommended by the wallcovering manufacturer, to the concrete and masonry walls as a substrate preparation. To promote adequate adhesion of wall lining over masonry walls, prime the walls as recommended by the wall lining manufacturer. Prime the surfaces of walls as required by the manufacturer's printed instructions to permit ultimate removal of wallcovering from the wall surfaces. Allow primer to completely dry before adhesive application.

3.3 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

3.3.1 Wallcovering

Install wallcovering in accordance with the manufacturer's printed installation instructions. Remove glue and adhesive spillage from wallcovering face and seams with a remover recommended by the manufacturer.

3.4 CLEAN-UP

Upon completion of the work, clean wallcovering free of dirt, soiling, stain, or residual film. Remove and clean surplus materials, rubbish, and debris resulting from the wallcovering installation.

-- End of Section --

SECTION 09 84 20

ACOUSTICAL WALL PANELS
08/16, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E84 (2020) Standard Test Method for Surface Burning Characteristics of Building Materials

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G

SD-03 Product Data

Installation

Acoustical Wall Panels; G

Recycled Content for Fabric Panels; S

SD-04 Samples

Acoustical Wall Panels

SD-07 Certificates

EPD; S

Recycled Content; S

Regional Material; S

VOC Emissions; S

Acoustical Wall Panels

SD-11 Closeout Submittals

Warranty

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for wall panels.

Provide regional material certifications for applicable materials.

1.2.1.3 IEQ Low-Emitting Materials

For Wall Panels applied inside the weatherproofing system - submit VOC statement indicating compliance with the;

a. VOC Emissions Evaluation

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Protect materials delivered and placed in storage from the weather, humidity and temperature variations, dirt, dust, or other contaminants.

1.4 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design (AWP-1)

Provide felt acoustical wall panel materials in the manufacturer's standard sizes and finishes of the type, design and configuration indicated.

2.1.1.1 Fabric Recycled Content

Fabric Panels must contain a minimum of 30 percent recycled content. Provide data identifying percentage of recycled content for fabric panels.

2.2 ACOUSTICAL WALL PANELS

Provide triangle acoustical wall panels consisting of 100 percent felt

core system as described below manufactured to the dimensions and configurations shown on the approved detail drawings; submit drawings showing plan locations, elevations and details of method of anchorage, location of doors and other openings, base detail and shape and thickness of materials. Acoustical wall panels installed in non-sprinklered areas must comply with the requirements of ICC IBC, Standard 42-2. Submit manufacturer's descriptive data and catalog cuts; felt swatches, 3 samples of each color range specified; and certificates of compliance from an independent laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards. A label or listing from the testing laboratory will be acceptable evidence of compliance. Wall panels must conform to the following:

2.2.1 Panel Width

Widths must be a minimum of 0.75 inches.

2.2.2 Panel Height

Heights must be a minimum of 0.75 inches.

2.2.3 Thickness

Provide panel thickness no less than 9mm / 0.35 inches.

2.2.4 Fire Rating for the Complete Composite System

Class A, 200 or less smoke density and flame spread less than 25, when tested in accordance with ASTM E84.

2.2.5 Noise Reduction Coefficient (NRC) Range

A minimum of 0.25

2.2.6 Edge Detail

45 degree beveled edge

2.2.7 Core Type

Felt core

2.2.8 Mounting Acoustical Panels

Mount acoustical panels with a construction adhesive per manufacturers direction.

2.3 COLOR

As indicated in drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

must be clean, smooth, oil free and prepared in accordance with panel manufacturer's instructions. Do not begin installation until all wet work, such as, plastering, painting, and concrete are completely dry.

3.2 INSTALLATION

Panel installation must be by personnel familiar with and normally engaged in installation of acoustical wall panels. Apply panels in accordance with the manufacturer's installation instructions. Submit manufacturer's installation instructions and recommended cleaning instructions.

3.3 CLEANING

Following installation, clean dirty or stained panel surfaces in accordance with manufacturer's instructions and leave free from defects. Remove and replace panels that are damaged, discolored, or improperly installed.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS

02/21

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

- a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
- b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.
- c. Existing coated surfaces that are damaged during performance of the work.

1.1.1.1 Exterior Painting

Includes new surfaces of the buildings and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.1.1.2 Interior Painting

Includes new surfaces of the buildings and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

- a. Exposed columns, girders, beams, joists, and metal deck; and
- b. Other contiguous surfaces.

1.1.2 Painting Excluded

Do not paint the following unless indicated otherwise.

- a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.
- b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.
- c. Steel to be embedded in concrete.
- d. Copper, stainless steel, aluminum, anodized aluminum, brass, and lead except existing coated surfaces.
- e. Hardware, fittings, and other factory finished items.

1.1.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

- (1) Exposed piping, conduit, and ductwork;
- (2) Supports, hangers, air grilles, and registers;
- (3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

- (1) New zinc-coated, aluminum, and copper surfaces under insulation
- (2) New aluminum jacket on piping
- (3) New interior ferrous piping under insulation.

1.1.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. In unfinished areas all conduit to be factory painted per specification 28 31 76.

1.1.4 Exterior Painting of Site Work Items

Field coat exterior steel sections of handrails and guardrails.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100	(2017; Suppl 2020) Documentation of the Threshold Limit Values and Biological Exposure Indices
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ASTM INTERNATIONAL (ASTM)

ASTM D235	(2002; R 2012) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D2369	(2010; R 2015; E 2015) Volatile Content of Coatings
ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

ASTM D4444	(2013; R 2018) Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters
ASTM D6386	(2016a) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F1869	(2016a) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)

Intelligence Bulletin 65	(2013) Occupational Exposure to Carbon Nanotubes and Nanofibers
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MASTER PAINTERS INSTITUTE (MPI)

MPI 4	(2016) Interior/Exterior Latex Block Filler
MPI 9	(2016) Alkyd, Exterior Gloss (MPI Gloss Level 6)
MPI 23	(2015) Primer, Metal, Surface Tolerant
MPI 38	(2016) Elastomeric Coating, Exterior, Water Based, Non-Flat
MPI 39	(2018) Primer, Latex, for Interior Wood
MPI 47	(2016) Alkyd, Interior, Semi-Gloss (MPI Gloss Level 5)
MPI 50	(2015) Primer Sealer, Latex, Interior
MPI 57	(2012) Varnish, Interior, Polyurethane, Oil Modified, Satin
MPI 72	(2016) Polyurethane, Two-Component, Pigmented, Gloss (MPI Gloss Level 6-7)
MPI 76	(2016) Primer, Alkyd, Quick Dry, for Metal
MPI 77	(2015) Epoxy, Gloss
MPI 79	(2016) Primer, Alkyd, Anti-Corrosive for Metal
MPI 90	(2012) Stain, Semi-Transparent, for Interior Wood
MPI 94	(2016) Alkyd, Exterior, Semi-Gloss (MPI

Gloss Level 5)

MPI 95	(2015) Primer, Quick Dry, for Aluminum
MPI 101	(2016) Primer, Epoxy, Anti-Corrosive, for Metal
MPI 107	(2016) Primer, Rust-Inhibitive, Water Based
MPI 113	(2018) Elastomeric, Pigmented, Exterior, Water Based, Flat
MPI 116	(2012) Block Filler, Epoxy
MPI 141	(2016) Latex, Interior, High Performance Architectural, Semi-Gloss (MPI Gloss Level 5)
MPI 145	(2016) Latex, Interior, Institutional Low Odor/VOC, (MPI Gloss Level 3)
MPI 147	(May 2016) Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (MPI Gloss Level 5)
MPI 149	(2016) Primer Sealer, Interior, Institutional Low Odor/VOC
MPI 163	(2016) Light Industrial Coating, Exterior, Water Based, Semi-Gloss (MPI Gloss Level 5)
MPI ASM	(2019) Architectural Painting Specification Manual
MPI GPS-1-14	(2014) Green Performance Standard GPS-1-14
MPI GPS-2-14	(2014) Green Performance Standard GPS-2-14
MPI MRM	(2015) Maintenance Repainting Manual

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning
SSPC 7/NACE No.4	(2007) Brush-Off Blast Cleaning
SSPC Glossary	(2011) SSPC Protective Coatings Glossary
SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC QP 1	(2019) Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors (Field Application to Complex Industrial Steel Structures and Other Metal Components)
SSPC SP 1	(2015) Solvent Cleaning

SSPC SP 2	(2018) Hand Tool Cleaning
SSPC SP 3	(2018) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC VIS 1	(2002; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC VIS 3	(2004) Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning
SSPC VIS 4/NACE VIS 7	(1998; E 2000; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC-SP WJ-1/NACE WJ-1	(2012) Clean to Bare Substrate, Waterjet Cleaning of Metals
SSPC-SP WJ-2/NACE WJ-2	(2012) Very Thorough Cleaning, Waterjet Cleaning of Metals
SSPC-SP WJ-3/NACE WJ-3	(2012) Thorough Cleaning, Waterjet Cleaning of Metals
SSPC-SP WJ-4/NACE WJ-4	(2012) Light Cleaning, Waterjet Cleaning of Metals

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A	(2017) Colors used in Government Procurement
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U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual
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U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(2014; Rev C) Color Code for Pipelines and for Compressed Gas Cylinders
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U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 24	(2000) Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings
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U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	(2018) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to
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Government Activities

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000

Air Contaminants

1.3 DEFINITIONS

1.3.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third-party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.3.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing must be accomplished by an MPI testing lab.

1.3.3 Coating

SSPC Glossary; (1) A liquid, liquefiable, or mastic composition that is converted to a solid protective, decorative, or functional adherent film after application as a thin layer; (2) Generic term for paint, lacquer, enamel.

1.3.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.3.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five levels are generically defined under the Assessment sections in the MPI MRM, MPI Maintenance Repainting Manual.

1.3.6 EXT

MPI short term designation for an exterior coating system.

1.3.7 INT

MPI short term designation for an interior coating system.

1.3.8 Loose Paint

Paint or coating that can be removed with a dull putty knife.

1.3.9 mil / mils

The English measurement for 0.001 in or one one-thousandth of an inch.

1.3.10 MPI Gloss Levels

MPI system of defining gloss. Seven gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units at 60 degree angle	Units at 80 degree angle
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.3.11 MPI System Number

The MPI coating system number in each MPI Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN).

1.3.12 Paint

SSPC Glossary; (1) Any pigmented liquid, liquefiable, or mastic composition designed for application to a substrate in a thin layer that is converted to an opaque solid film after application. Used for protection, decoration, identification, or to serve some other functional purposes; (2) Application of a coating material.

1.3.13 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.3.14 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

1.4 SCHEDULING

Allow paint, polyurethane, varnish, and wood stain installations to cure prior to the installation of materials that adsorb VOCs, including carpets,

textiles, unprimed gypsum wallboard, and acoustical ceiling panels.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-02 Shop Drawings

Piping Identification

SD-03 Product Data

Coating; G

Product Data Sheets

SD-04 Samples

Color; G

SD-07 Certificates

Qualification Testing laboratory for coatings; G

EPD(s); S

VOC Emissions; S

VOC Content; S

SD-08 Manufacturer's Instructions

Mixing

Manufacturer's Safety Data Sheets

SD-10 Operation and Maintenance Data

Take-Back Program; S

Coatings, Data Package 1; G

1.5.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.5.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.5.1.2 M&R Sourcing of Raw Materials

Provide Extended Producer Responsibility (EPR/Product Take-Back Programs) data.

1.5.1.3 IEQ Low-Emitting Materials

For Paints and Coatings submit VOC statement indicating compliance with the;

a. VOC Emissions Evaluation

b. VOC Content Evaluation

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

1.6.1.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.6.1.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.6.1.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.6.1.4 Asbestos Content

Provide asbestos-free materials.

1.6.1.5 Mercury Content

Provide materials free of mercury or mercury compounds.

1.6.1.6 Silica

Provide abrasive blast media containing no free crystalline silica.

1.6.1.7 Human Carcinogens

Provide materials that do not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6.1.8 Carbon Based Fibers / Tubes

Materials must not contain carbon based fibers such as carbon nanotubes or carbon nanofibers. Intelligence Bulletin 65 ranks toxicity of carbon nanotubes on a par with asbestos.

1.6.2 SSPC QP 1 Certification

Contractors that perform surface preparation or coating application on steel substrates must be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to Contract award, and must remain certified while accomplishing any surface preparation or coating application. If a Contractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Notify the Contracting Officer of any change in Contractor certification status. Notify the Contracting Officer of all scheduled and unannounced on-site audits from SSPC and furnish a copy of all audit reports.

1.6.3 Approved Products List

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of Contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire Contract and each coating system is to be from a single manufacturer. Provide all coats on a particular substrate from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

1.6.4 Paints and Coatings Indoor Air Quality Certifications

Provide paint and coating products certified to meet indoor air quality requirements by MPI GPS-1-14, MPI GPS-2-14 or provide certification by other third-party programs. Provide current product certification documentation from certification body.

Provide certification of VOC Emissions and VOC Content for Paints and Primers. Submit required indoor air quality certifications in one submittal package.

1.6.5 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph SAMPLING PROCEDURE. Test each chosen product as specified in the paragraph TESTING PROCEDURE. Remove products from the job site which do not conform, and replace with new products that conform to the referenced specification. Test replacement products that failed initial testing as specified in the paragraph TESTING PROCEDURE at no cost to the Government.

1.6.5.1 Sampling Procedure

Select paint at random from the products that have been delivered to the job site for sample testing. The Contractor must provide one quart samples of the selected paint materials. Take samples in the presence of the Contracting Officer, and label, and identify each sample. Provide labels in accordance with the paragraph PACKAGING, LABELING, AND STORAGE.

1.6.5.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as

defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph QUALIFICATION TESTING laboratory for coatings. Include the backup data and summary of the test results within the qualification testing lab report. Provide a summary listing of all the reference specification requirements and the result of each test. Clearly indicate in the summary whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If MPI is chosen to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.7 PACKAGING, LABELING, AND STORAGE

Provide paints in sealed containers that legibly show the Contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Furnish pigmented paints in containers not larger than 5 gallons. Store paints and thinners in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F. Do not store paint, polyurethane, varnish, or wood stain products with materials that have a high capacity to absorb VOC emissions. Do not store paint, polyurethane, varnish, or wood stain products in occupied spaces.

1.8 SAFETY AND HEALTH

Comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. Include in the Activity Hazard Analysis the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.8.1 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

- a. The applicable manufacturer's Safety Data Sheets (SDS) or local regulation.
- b. 29 CFR 1910.1000.
- c. ACGIH 0100, threshold limit values.

Submit manufacturer's Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

1.9 ENVIRONMENTAL REQUIREMENTS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation. Isolate area of application from rest of building when applying high-emission paints or coatings.

1.9.1 Coatings

Do not apply coating when air or substrate conditions are:

- a. Less than 5 degrees F above dew point;
- b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Do not, under any circumstances, violate the manufacturer's application recommendations.

1.9.2 Post-Application

Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms. Maintain one of the following ventilation conditions during the curing period, or for 72 hours after application:

- a. Supply 100 percent outside air 24 hours a day.
- b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 85 degrees F and humidity is between 30 percent and 60 percent.
- c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit Product Data Sheets for specified coatings and solvents. Provide preprinted cleaning and maintenance instructions for all coating systems. Submit Manufacturer's Instructions on Mixing: Detailed mixing instructions, minimum and maximum application temperature and humidity, pot life, and curing and drying times between coats.

2.2 COLOR CODING FOR SHORE-TO SHIP UTILITY CONNECTIONS

Color Coding For Shore-To-Ship Utility Connections: Paint hose connection fittings and shut-off valves the designated color. In addition to color coding provide 2 inch high stenciled letters using black stencil paint, clearly designating service for each connection.

Color Coding for Shore-to-Ship		
Utility Connections		
Service	Color	SAE AMS-STD-595A No.
Potable Water*	Blue	15044
Water Provided for Fire Protection**	Red	11105
Chilled Water	Striped Blue/White	15044 / 17886
Oily Waste Water	Striped Yellow/Black	13528 / 17038
Sewer	Gold	17043
Steam	White	17886
High Pressure Air	Gray	16081
Low Pressure Air	Tan	10324
Fuels	Yellow	13655
* This includes connections serving domestic functions.		
** This includes non-potable salt water or, at some locations, fresh water connections provided for fire protection (may also include flushing and cooling requirements). Note: This does not include waterfront fire hydrants.		

2.3 COLOR SELECTION OF FINISH COATS

Provide colors of finish coats as indicated or specified. Allow Contracting Officer to select colors not indicated or specified. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors are approximately the colors indicated and the product conforms to specified requirements.

Provide color, texture, and pattern of wall coating systems as indicated. Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated. Submit color stencil codes. Tint each coat progressively darker to enable confirmation of the number of coats.

2.4 Epoxy Wall System (EW-1)

- a. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. Basecoat

- (a) A two-component urethane membrane.

2. First Topcoat

(a) A two-component waterborne, aliphatic, polyurethane coating.

3. Second Topcoat

(a) A two-component waterborne, aliphatic, polyurethane coating.

2.4.1 Physical Properties

Provide wall system in which physical properties of topping when tested in accordance with standards or procedures referenced below, are as follows:

- a. Pot Life: Basecoat 20 minutes @ 70°F/21°C, Topcoat 35 to 40 minutes @ 70 degree F/21 degree C
- b. Minimum Dry Film Thickness: 12 to 15 mil/304 to 381 microns
- c. Cure Rate: 12 hours for tack free surface (@77°F/25°C) 24 hours minimum for normal operations
- d. Temperature Limitations: 140°F/60°C for continuous exposure and 200°F/93°C intermittent exposure
- e. Fire Resistance of Dry Film: Class B (ASTM E84), Flame Spread 40, Smoke Develop 115. V.O.C: basecoat - 10g/l, VSE Topcoat - 5 g/l (ASTM D2369)

2.4.2 Joint Sealant Materials

Type produced by manufacturer of resinous wall system for type of service and joint condition indicated.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, reinstall removed items by workmen skilled in the trades. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Schedule cleaning so that dust and other contaminants will not fall on wet, newly painted surfaces. Spot-prime exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas. Refer to MPI ASM and MPI MRM for additional more specific substrate preparation requirements.

3.2.1 Substrate Repair

- a. Repair substrate surface damaged during coating removal;
- b. Clean and prime the substrate as specified.

3.3 PREPARATION OF METAL SURFACES

3.3.1 New Ferrous Surfaces

- a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6/NACE No.3, or SSPC SP 10/NACE No. 2. Brush-off blast remaining surface in accordance with SSPC 7/NACE No.4; Water jetting to SSPC-SP WJ-4/NACE WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Protect shop-coated ferrous surfaces from corrosion by treating and touching up corroded areas immediately upon detection.

3.3.2 Final Ferrous Surface Condition:

3.3.2.1 Tool Cleaned Surfaces

Comply with SSPC SP 2 and SSPC SP 3. Use as a visual reference, photographs in SSPC VIS 3 for the appearance of cleaned surfaces.

3.3.2.2 Abrasive Blast Cleaned Surfaces

Comply with SSPC 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. Use as a visual reference, photographs in SSPC VIS 1 for the appearance of cleaned surfaces.

3.3.2.3 Waterjet Cleaned Surfaces

Comply with SSPC-SP WJ-1/NACE WJ-1, SSPC-SP WJ-2/NACE WJ-2, SSPC-SP WJ-3/NACE WJ-3 or SSPC-SP WJ-4/NACE WJ-4. Use as a visual reference, photographs in SSPC VIS 4/NACE VIS 7 for the appearance of cleaned surfaces.

3.3.3 Galvanized Surfaces

- a. New Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. Completely remove coating by brush-off abrasive blast if the galvanized metal has been passivated or stabilized. Do not "passivate" or "stabilize" new galvanized steel to be coated. If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D6386, Appendix X2, and remove by one of the methods described therein.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash

with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.3.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D235. Wipe dry with clean, dry cloths.

3.4 PREPARATION OF CONCRETE

3.4.1 Concrete

- a. Curing: Allow concrete, stucco and masonry surfaces to cure at least 30 days before painting, and concrete slab on grade to cure at least 90 days before painting.
- b. Surface Cleaning: Remove the following deleterious substances.
 - (1) Dirt, Chalking, Grease, and Oil: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. Wash existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.
 - (2) Fungus and Mold: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.
 - (3) Paint and Loose Particles: Remove by wire brushing.
 - (4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.
- c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.
- d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F1869. In all cases follow manufacturer's recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board

3.4.2.1 Surface Cleaning

Verify that plaster and stucco surfaces are free from loose matter and that gypsum board is dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be

used if paint is water-based.

3.4.2.2 Repair of Minor Defects

Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

3.4.2.3 Allowable Moisture Content

Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D4263. Verify that new plaster to be coated has a maximum moisture content of 8 percent, when measured in accordance with ASTM D4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces, Except Floors:

- a. Surface Cleaning: Clean wood surfaces of foreign matter. Verify that surfaces are free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood.
- b. Removal of Fungus and Mold: Wash existing coated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, one ounce (1/3 cup) household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.
- c. Do not exceed 12 percent moisture content of the wood as measured by a moisture meter in accordance with ASTM D4444, Method A, unless otherwise authorized.
- d. Prime or touch up wood surfaces adjacent to surfaces to receive water-thinned paints before applying water-thinned paints.
- e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.
- f. Cosmetic Repair of Minor Defects:
 - (1) Knots and Resinous Wood: Prior to application of coating, cover knots and stains with two or more coats of 3-pound-cut shellac varnish, plasticized with 5 ounces of castor oil per gallon. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.
 - (2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.
 - (3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

3.5.2 Interior Wood Surfaces, Stain Finish

Sand interior wood surfaces to receive stain. Fill oak and other open-grain wood to receive stain with a coat of wood filler not less than 8 hours before the application of stain; remove excess filler and sand the surface smooth.

3.6 APPLICATION

3.6.1 Coating Application

- a. Comply with applicable federal, state and local laws enacted to ensure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.
- b. At the time of application, paint must show no signs of deterioration. Maintain uniform suspension of pigments during application.
- c. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Use rollers for applying paints and enamels of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.
- d. Only apply paints, except water-thinned types, to surfaces that are completely free of moisture as determined by sight or touch.
- e. Thoroughly work coating materials into joints, crevices, and open spaces. Pay special attention to ensure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.
- f. Apply each coat of paint so that dry film is of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Completely hide all blemishes.
- g. Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Unfinished spaces include attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. Upon completion of painting, remove protective covering from sprinkler heads.
- h. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel (MPI 9) applied to a minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.
- i. Piping in Finished Areas: Provide primed surfaces with two coats of

paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel (MPI 9) applied to a minimum dry film thickness of 1.0 mil or two component gloss polyurethane (MPI 72) in exterior applications.

- j. Provide labeling on the surfaces of all feed and cross mains to show the pipe function such as "Sprinkler System", "Fire Department Connection", "Standpipe". For pipe sizes 4-inch and larger provide white painted stenciled letters and arrows, a minimum of 2 in in height and visible from at least two sides when viewed from the floor. For pipe sizes less than 4-inch, provide white painted stenciled letters and arrows, a minimum of 0.75 in in height and visible from the floor.
- k. All fire suppression system valves must be marked with permanent tags indicating normally open or normally closed.
- l. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.
- m. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Cover each preceding coat or surface completely by ensuring visually perceptible difference in shades of successive coats.
- n. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.
- o. Thermosetting Paints: Apply topcoats over thermosetting paints (epoxies and urethanes) within the overcoat window recommended by the manufacturer.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. Verify that the written permission includes quantities and types of thinners to use.

When thinning is allowed, thin paints immediately prior to application with not more than one pint of suitable thinner per gallon. The use of thinner does not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning cannot cause the paint to exceed limits on volatile organic compounds. Do not mix paints of different manufacturers.

3.6.3 Two-Component Systems

Mix two-component systems in accordance with manufacturer's instructions. Follow recommendation by the manufacturer for any thinning of the first coat to ensure proper penetration and sealing for each type of substrate.

3.6.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table for Exterior Applications	
MPI Division	Substrate Application
MPI Division 3	Exterior Concrete Paint Table
MPI Division 4	Exterior Concrete Masonry Units Paint Table
MPI Division 5	Exterior Metal, Ferrous and Non-Ferrous Paint Table

Table for Interior Applications	
MPI Division	Substrate Application
MPI Division 4	Interior Concrete Masonry Units Paint Table
MPI Division 5	Interior Metal, Ferrous and Non-Ferrous Paint Table
MPI Division 6	Interior Wood Paint Table
MPI Division 9	Interior Gypsum Board Surfaces Paint Table

- b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness, where specified, refers to the minimum dry film thickness.
- c. Coatings for Surfaces Not Specified Otherwise: Coat unspecified surfaces the same as surfaces having similar conditions of exposure.
- d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:
- (1) One coat of primer.
 - (2) One coat of undercoat or intermediate coat.
 - (3) One topcoat to match adjacent surfaces.
- e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces

where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in MPI Division 5 for Exterior and Interior.

- a. Apply specified ferrous metal primer to steel surfaces on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.
- b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.
- c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.
- d. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat. Overcoat these items with the specified ferrous-metal primer prior to application of finish coats.
- e. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.8 COATING SYSTEMS FOR CONCRETE

Apply coatings of Tables in MPI Division 3, 4 and 9 for Exterior and Interior.

3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD

- a. Apply coatings of Tables in MPI Division 6 for Exterior and Interior.
- b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.
- c. Apply stains in accordance with manufacturer's printed instructions.

3.10 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.11 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.12 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. When such a service is not available, contact local recyclers to reclaim the materials. Set aside extra paint for future color matches or reuse by the Government. Where local options exist for leftover paint recycling, collect all waste paint by type and provide for delivery to recycling or collection facility for reuse by local organizations.

3.13 PAINT TABLES

All DFT's are minimum values. Use only materials with a MPI GPS-1-14 green check mark having a minimum MPI "Environmentally Friendly" E1 rating based on VOC (EPA Method 24) content levels. Acceptable products are listed in the MPI Green Approved Products List, available at <http://www.specifygreen.com/APL/ProductIdxByMPInum.asp>.

3.13.1 Exterior Paint Tables

3.13.1.1 MPI Division 3: Exterior Concrete Paint Table

A. Concrete; Vertical Surfaces

(1) New concrete; Elastomeric System; vertical surfaces

Elastomeric System					
New		Primer	Intermediate	Topcoat	System DFT
MPI EXT 3.1F-G2.3 (Velvet)		Per manufacturer	MPI 38	MPI 38	400 microns 16 mils
Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions. NOTE: Apply sufficient coat to achieve a minimum dry film thickness of 400 microns 16 mils					

3.13.1.2 MPI Division 4: Exterior Concrete Masonry Units Paint Table

C. New concrete masonry, elastomeric system; on uncoated surfaces

Elastomeric Coating					
New and uncoated existing	Existing, previously painted	Primer	Intermediate	Topcoat	System DFT
MPI EXT 3.1F-G1 (Flat)	MPI REX 3.1F-G1 (Flat)	Per Manufacturer	MPI 113	MPI 113	400 microns 16 mils
Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions. NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film thickness of 400 microns 16 mils.					

3.13.1.3 MPI Division 5: Exterior Metal, Ferrous and Non-Ferrous Paint Table

A. Steel / Ferrous Surfaces

(1) New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

Alkyd					
New	Existing, uncoated	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.1Q-G5 (Semigloss)	MPI REX 5.1D-G5 (Semigloss)	MPI 23	MPI 94	MPI 94	5.25 mils
Topcoat: Coating to match adjacent surfaces.					

(2) New Steel that has been blast-cleaned to SSPC SP 6/NACE No.3

Alkyd					
MPI EXT 5.1D-G5 (Semigloss)	MPI REX 5.1D-G5 (Semigloss)	MPI 79	MPI 94	MPI 94	131 microns 5.25 mils
Topcoat: Coating to match adjacent surfaces.					

B. Exterior Galvanized Surfaces

(1) New Galvanized surfaces

Epoxy Primer / Waterborne Light Industrial Coating				
New Galvanized Surfaces	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.3K-G5 (Semigloss)	MPI 101	MPI 163	MPI 163	5 mils
Topcoat: Coating to match adjacent surfaces.				

C. Exterior Surfaces, Other Metals (Non-Ferrous)

(1) Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment

Waterborne Light Industrial Coating				
New Galvanized Surfaces	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.4F-G5 (Semigloss)	MPI 95	MPI 163	MPI 163	5 mils
Topcoat: Coating to match adjacent surfaces.				

(3) Surfaces adjacent to painted surfaces; Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment

Waterborne Light Industrial Coating				
New	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.1C-G5 (Semigloss)	MPI 79	MPI 163	MPI 163	5 mils
Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces.				

3.13.2 Interior Paint Tables

3.13.2.1 MPI Division 4: Interior Concrete Masonry Units Paint Table

A. New Concrete Masonry

Institutional Low Odor / Low VOC Latex					
New	Filler	Primer	Intermediate	Topcoat	System DFT
MPI INT 4.2E-G3 (Eggshell)	MPI 4	N/A	MPI 145	MPI 145	4 mils
Fill all holes in masonry surface					

C. New Concrete masonry units in restrooms, and other high humidity areas unless otherwise specified

Epoxy					
New	Filler	Primer	Intermediate	Topcoat	System DFT
MPI INT 4.2G-G6 (Gloss)	MPI 116	N/A	MPI 77	MPI 77	10 mils
Fill all holes in masonry surface					

3.13.2.2 MPI Division 5: Interior Metal, Ferrous and Non-Ferrous Paint Table

A. Interior Steel / Ferrous Surfaces

(1) Metal, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, Surfaces adjacent to painted surfaces (Match surrounding finish), exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment

High Performance Architectural Latex				
New	Primer	Intermediate	Topcoat	System DFT
MPI INT 5.1R-G5 (Semigloss)	MPI 76	MPI 141	MPI 141	5 mils
Topcoat: Coating to match adjacent surfaces.				

(3) Metal in restrooms, and other high-humidity areas not otherwise specified except floors, hot metal surfaces, and new prefinished equipment

Alkyd				
New, uncoated Existing	Primer	Intermediate	Topcoat	System DFT
MPI INT 5.1E-G5 (Semigloss)	MPI 76	MPI 47	MPI 47	5.25 mils
Topcoat: Coating to match adjacent surfaces.				

3.13.2.3 MPI Division 6: Interior Wood Paint Table

A. Interior Wood and Plywood

(1) New Wood and plywood not otherwise specified

Institutional Low Odor / Low VOC Latex				
New, uncoated Existing	Primer	Intermediate	Topcoat	System DFT
MPI INT 6.3V-G5 (Semigloss)	MPI 39	MPI 147	MPI 147	4 mils

G. Interior New Wood Doors; Natural Finish or Stained

Stained, oil-modified polyurethane						
New		Stain	Primer	Intermediate	Topcoat	System DFT
MPI INT 6.3E-G4		MPI 90	MPI 57	MPI 57	MPI 57	4 mils
Note: Sand between all coats per manufacturers recommendations.						

3.13.2.4 MPI Division 9: Gypsum Board, Textured Surfaces Paint Table

A. Interior New Wallboard not otherwise specified

Institutional Low Odor / Low VOC Latex, New

Institutional Low Odor / Low VOC Latex				
New	Primer	Intermediate	Topcoat	System DFT
MPI INT 9.2M-G3 (Eggshell)	MPI 149	MPI 145	MPI 145	4 mils

Topcoat: Coating to match adjacent surfaces.

B. Interior New Wallboard in restrooms, and other high humidity areas not otherwise specified

Epoxy, New

Epoxy				
New	Primer	Intermediate	Topcoat	System DFT
MPI INT 9.2E-G6 (Gloss)	MPI 50	MPI 77	MPI 77	4 mils
Topcoat: Coating to match adjacent surfaces.				

3.14 Epoxy Wall System

3.14.1 Preparation

- a. Masonry Substrate: Comply with SSPC-SP3. Masonry shall be clean and free of bond inhibiting materials such as previously applied coatings. Preparation of existing coatings shall be by mechanical means and may include grinding and light sanding. Penetrations, gouges and "bug holes" shall be filled with Stonset PM5 patching mortar.

3.14.2 Application

- a. General: Apply each component of resinous wall system in compliance with manufacturer's directions to produce a uniform monolithic wearing surface of thickness indicated, uninterrupted except at divider strips, sawn joints or other types of joints (if any), indicated or required.
- b. Primer: Mix and apply material according to manufacturer's recommended procedures.
- c. Epoxy Base Coat: Mix epoxy base coat components with fiberglass additive. Apply base coat to primed wall surface.
- d. Top Coat: Mix material according to manufacturer's recommended procedures.

3.14.3 Field Quality Control

- a. The right is reserved to invoke the following material testing procedure at any time, and any number of times during period of wall application.
- b. The Owner will engage service of an independent testing laboratory to sample materials being used on the job site. Samples of material will

be taken, identified and sealed, and certified in presence of Contractor.

- c. Testing laboratory will perform tests for any of characteristics specified, using applicable testing procedures referenced herein, or if none referenced, in manufacturer's product data.

- 1. If test results show materials being used do not comply with specified requirements, Contractor may be directed by Owner to stop work; remove non-complying materials; pay for testing; reapply wall materials to properly prepared surfaces which had previously been coated with unacceptable materials.

3.14.4 Curing, Protecting and Cleaning

- a. Cure resinous wall materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.
- b. Protect resinous wall materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.
- c. Cleaning: Remove temporary covering and clean resinous wall system just prior to final inspection. Use cleaning materials and procedures recommended by resinous wall system manufacturer. General contractor is responsible for cleaning prior to inspection.

-- End of Section --

SECTION 09 97 13.26

COATING OF STEEL WATERFRONT STRUCTURES

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D7091	(2021) Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nondestructive Coatings Applied to Non-Ferrous Metals
ASTM E376	(2019) Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PS 13.01	(1982; E 2004) Epoxy-Polyamide Painting System
SSPC Paint 22	(1982; E 2004) Paint Specification No. 22 Epoxy-Polyamide Paints (Primer, Intermediate, and Topcoat)
SSPC QP 1	(2019) Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors (Field Application to Complex Industrial Steel Structures and Other Metal Components)
SSPC SP 1	(2015) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Epoxy-Polyamide; G

1.3 ENVIRONMENTAL CONDITIONS

Start work only when ambient and curing temperatures are within limits of coating manufacturer's recommendations and at least 5 degrees F above dew point temperature. Coating system shall be shop applied.

1.4 SAFETY AND HEALTH PRECAUTIONS

Materials listed in this section contain coal tar pitch volatiles, which are toxic. Follow safety procedures as recommended by manufacturer. Work in a well ventilated area. Provide, and require workers to use, impervious clothing, gloves, face shields (8 inch minimum), and other appropriate protective clothing necessary to prevent eye and skin contact with coating materials. Keep coatings away from heat, sparks and flame.

1.5 SSPC QP 1 CERTIFICATION

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay of the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in contractor certification status.

PART 2 PRODUCTS

2.1 COATING SYSTEMS

2.1.1 Coating

Provide catalyst components for coatings specific for resin components. Use thinners which are compatible with the coating.

2.1.1.1 Epoxy-Polyamide

a. System: SSPC PS 13.01

b. Paints: SSPC Paint 22, Primer, Intermediate and Top Coats, Black

PART 3 EXECUTION

3.1 CLEANING AND PREPARATION OF SURFACES

3.1.1 Solvent Cleaning

SSPC SP 1. Remove visible oil, grease, and drawing and cutting compounds by solvent cleaning.

3.1.2 Blast Cleaning

SSPC SP 10/NACE No. 2. After solvent cleaning, complete surface preparation by near-white blast cleaning. Remove residual dust from

blasted surface by blowing with dry, oil-free air, vacuuming, or sweeping. Provide surface profile of at least 1 1/2-mil thickness.

3.2 PROPORTIONING AND MIXING OF COATING SYSTEM

3.2.1 Proportioning of Epoxy-Polyamide System

Epoxy-polyamide coatings consist of a two-component system that includes a pigmented polyamide resin, Component A and an epoxy resin, Component B. Mix both components in a ratio of 1 to 1 by volume. Do not thin coatings when doing so will result in total volatile organic compounds exceeding limits enacted by local air pollution control district. When thinning is allowed and is necessary, such as during cold temperature application or to improve application characteristics, add up to one pint of ethylene glycol monoethyl (EGM) ether for each gallon of the coating.

3.2.2 Mixing of Epoxy-Polyamide System

Mix components of coating by power stirring until a smooth, uniform consistency results. Stir coating periodically during its induction period. Follow Table 1 for induction time and pot life of mixed batches.

Table 1
JOB SITE AMBIENT TEMPERATURE AND
INDUCTION TIME FOR EPOXY-POLYAMIDE SYSTEM

Ambient Temperature Degrees F	Induction Time (in hours)
40 to 50	2 at 70 degrees F
50 to 60	2
60 to 70	1 to 1-1/2
70 and above	1/2 to 1

3.3 COATING APPLICATION

3.3.1 General

Apply primer coating to dry surfaces not more than 4 hours after near-white blast cleaning. Apply coats of each system so that finished surfaces are free from runs, sags, brush marks and variations in color.

3.3.1.1 Application Method for Epoxy-Polyamide System

Allow previous coat to dry to tack-free condition but not more than 72 hours before applying next coat. If more than 72 hours elapses between coats, clean surface, apply a 2 mil wet film thickness of previous coat, allow to cure to a tacky film, and apply a full thickness of next coat.

3.3.2 Repair of Defects

Repair detected coating holidays, thin areas, and exposed areas damaged prior to or during installation by surface treatment and application of additional coating or by manufacturer's recommendations. Allow a period

of at least 72 hours to pass following final coat before placing in immersion service.

3.3.3 Three-Coat Epoxy-Polyamide System

Apply each coat at a dry film thickness of between 3 mils and 4 mils.

3.3.4 Dry Film Thickness

Provide total system minimum dry film thickness of 9 mils. Measure using a magnetic gage.

3.4 SURFACES TO BE COATED

3.4.1 Steel Bearing Piles, tops of steel fender piles, steel guide piles and Steel Combination Bulkheads

Coating shall be shop applied prior to installation. Coating damaged by any cause shall be reapplied using the same surface preparation and application specified herein on all affected areas.

- a. The exterior (onshore and offshore sides) top 30 feet of steel combination (bulkhead) pipe piles and connectors must be coated. Inside faces of connectors that will mate with other connectors do not require coating.
- b. The top 30 feet of the inboard and outboard faces of sheet piles and interlocks must be coated. Inside faces of interlocks and connectors that will mate with other connectors do not require coating.
- c. The exterior, top 60 feet of steel pipe (fender) piles must be coated.
- d. The exterior, top 60 feet of steel pipe (bearing) piles must be coated.

3.5 FIELD TESTS

Conduct testing in presence of Contracting Officer.

3.5.1 Holiday Testing

Prior to installation, test for holidays in total coating system. Use a low-voltage holiday detector of less than 90 volts in accordance with manufacturer's instructions. After repair of holidays by surface treatment and application of additional coating or by manufacturer's recommendation, retest with a low-voltage holiday detector.

3.5.2 Dry Film Thickness

After repair of holidays, measure dry film thickness using a magnetic dry film thickness gage in accordance with ASTM D7091 and ASTM E376. Re-measure after an additional coat is applied, and add it to meet minimum thickness requirements.

-- End of Section --

SECTION 10 14 00.10

EXTERIOR SIGNAGE
08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 268 (2014) Standard Specification for
Retroreflective Sheeting for Flat and
Vertical Traffic Control Applications

AMERICAN WELDING SOCIETY (AWS)

AWS C1.1M/C1.1 (2012) Recommended Practices for
Resistance Welding

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding
Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products

ASTM A653/A653M (2020) Standard Specification for Steel
Sheet, Zinc-Coated (Galvanized) or
Zinc-Iron Alloy-Coated (Galvannealed) by
the Hot-Dip Process

ASTM A924/A924M (2020) Standard Specification for General
Requirements for Steel Sheet,
Metallic-Coated by the Hot-Dip Process

ASTM B26/B26M (2018; E 2018) Standard Specification for
Aluminum-Alloy Sand Castings

ASTM B108/B108M (2019) Standard Specification for
Aluminum-Alloy Permanent Mold Castings

ASTM B209 (2014) Standard Specification for Aluminum
and Aluminum-Alloy Sheet and Plate

ASTM B221 (2021) Standard Specification for Aluminum
and Aluminum-Alloy Extruded Bars, Rods,
Wire, Profiles, and Tubes

ASTM D4956 (2013) Standard Specification for

Retroreflective Sheeting for Traffic
Control

ASTM E84

(2020) Standard Test Method for Surface
Burning Characteristics of Building
Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70

(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS3611

(2011; Rev E; Stabilized (S) 2011) Plastic
Sheet, Polycarbonate General Purpose

1.2 GENERAL REQUIREMENTS

All exterior signage must be provided by a single manufacturer. Exterior signage must be of the design, detail, sizes, types, and message content shown on the drawings, must conform to the requirements specified, and must be provided at the locations indicated. Submit exterior signage schedule in electronic media with spread sheet format. Spread sheet must include sign location, sign type, and message. Signs must be complete with graphics, framing as detailed, and related components for a complete installation including building mounting system design. Each sample must consist of a complete sign panel with graphics. Submit 2, 12 inch square sign face color samples.

1.2.1 Load Requirements

Exterior signage and anchorage must be designed to withstand loading requirements as indicated on structural drawings. Submit design analysis and supporting calculations performed in support of specified signage.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G

Including attachment to building

SD-03 Product Data

Installation

Exterior Signage; G

SD-04 Samples

Exterior Signage; G

SD-05 Design Data

Exterior Signage Mounting Calculations; G

Illuminance; G

SD-10 Operation and Maintenance Data

Protection and Cleaning; G

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters must be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment must essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials must be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period must be provided.

PART 2 PRODUCTS

2.1 EXTERIOR SIGNAGE

2.1.1 Building Exterior Wall Mounted Signage

Provide 5 inch deep alum framed logo. Face to be polycarbonate with translucent vinyl graphic. Face to be lit internally from behind.

2.1.1.1 Framing

Perimeter framing must consist of aluminum angle framing welded attached to continuous aluminum back and return plates. Framing members must be designed to permit access to electrical equipment and panel removal. Mounting must be provided as shown. Openings must be sealed from moisture and made tamper-proof.

2.1.1.2 Exterior Sheeting Panels

Modular panels must be provided in sizes shown on drawings. Panels must be fabricated a minimum of 3/16 inch polycarbonate. Sheeting panel must be removable and must be secured by 3/16 inch socket head jack nuts. Logo on polycarbonate panel to be translucent vinyl graphics with a UV laminate.

2.1.1.3 Mounting

Signage mounting to be designed by a licensed engineer. Exterior sign

mounting to withstand loading as indicated on drawings. Mounting to be fully concealed behind signage. Provide exterior signage mounting calculations.

2.1.2 Waterfront Exterior Signage

2.1.2.1 Flat Aluminum Sign Panels

Aluminum sign panels must conform to ASTM B209, alloy-temper 6061-T6 or 5052-H38. The blanks must be free from laminations, blisters, open seams, pits, holes, other defects that may affect their appearance or use. The thickness must be uniform and the blank commercially flat.

2.1.2.2 Extruded Aluminum Sign Panels

Conform to ASTM B221, alloy 6063-T6. The maximum allowable deviation from flat on the face is 0.05 inches per foot.

2.1.2.3 Retroreflective Sheeting

All background sheeting applied to flat sheet and extruded panel signs must be in accordance with ASTM D4956, Type III, IV, VII, VIII, IX or XI retroreflective sheeting and must have Class 1, 3, or 4 adhesive backing. Retroreflective sheeting must be high intensity that is an unmetallized micro prismatic reflective material. Retroreflective sheeting must have sufficient adhesion, strength and flexibility such that the sheeting can be handled, processed and applied according to the manufacturer's recommendations without appreciable stretching, tearing, cracking or other damage.

2.1.2.3.1 Legend and Border

Apply retroreflective sheeting as legend and border in accordance with ASTM D4956, Type IX, XI, or AASHTO M 268 Type C or D, Class 1. Retroreflective sheeting must be an unmetallized cube corner microprismatic reflective material. Retroreflective sheeting applied as legend and border for specific signing applications, without a datum mark on the surface of the sheeting, must be evaluated for rotational sensitivity in accordance with AASHTO M 268, Section 3.3.1 and fabricated in accordance with AASHTO M 268, Section 3.3.2.

2.1.2.3.2 Screen Printed Transparent Colored Areas

For screen printed transparent colored areas or transparent colored overlay films on white sheeting, the coefficient of retroreflection (RA) must be no less than 70 percent of the original values for the corresponding color.

2.1.2.3.3 Adhesive Performance

Adhesive performance for retroreflective sheeting must be in accordance with ASTM D4956. The sheeting surface must be in condition to be readily screen processed and compatible with transparent overlay films, plus recommended transparent and opaque screen process colors. Furnish manufacturer's information as to the type of solvent or solvents that may be used to clean the surface of the sheeting without detrimental loss of performance and durability.

2.1.2.4 Letters, Numerals, Arrows, Symbols, and Borders

Apply letters, numerals, arrows, symbols, and borders on the retroreflective sheeting or opaque background of the sign using the direct or reverse screen process. Apply messages and borders of a color darker than the background to the paint or the retroreflective sheeting using the direct process. Messages and borders must be of a color lighter than the sign background and applied using the reverse screen process. Use opaque or transparent colors, inks, and paints of the type and quality recommended by the retroreflective sheeting manufacturer in the screen process. Perform the screening in a manner that results in a uniform color and tone, with sharply defined edges of legends and borders and without blemishes on the sign background that will affect intended use. Air dry or bake the signs after screening according to the manufacturer's recommendations to provide a smooth hard finish. Reject any signs with blister's or other blemishes.

2.1.2.5 Hardware

Bolts, nuts, post clips, lock and flat washers must be commercial quality Type 316 or 316L stainless steel. Provide commercial quality nylon or Teflon insulating washers between stainless steel washers and aluminium sign panels.

2.2 ILLUMINATION

Concealed lighting must be provided within panel frame members. Lighting must be controlled by a photocell device. Back lighting must be provided by white LED modules. Wiring within the sign must be in metal raceways. Electrical equipment must be UL or FM listed and comply with NFPA 70. Illumination must be evenly distributed. A switch on the interior of the sign must be provided to turn off power in the sign. Switch must be readily accessible when sign is open.

2.2.1 Illuminance

Each sign must not exceed a luminance of 200 cd/m² (Nits) during nighttime hours.

Each sign must not exceed a luminance of 2,000 cd/m² (Nits) during daytime hours.

2.3 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.3.1 Graphics

Signage graphics must conform to the following:

2.3.2 Messages

See drawings.

2.4 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products must conform to ASTM B209 for sheet or plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Aluminum extrusions must be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products must conform to AWS C1.1M/C1.1. Alum framing finish to match

storefront finish refer to Aluminum Window specification 08 51 13.

2.5 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting must be 5 to 7 year premium type and must be in accordance with the flammability requirements of ASTM E84 and must be a minimum 0.003 inch film thickness. Film must include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3. Vinyl sheeting to have a UV laminate.

2.6 POLYCARBONATE SHEET

Polycarbonate sheet must conform to SAE AMS3611.

2.7 ANCHORS AND FASTENERS

Exposed anchor and fastener materials must be compatible with metal to which applied and must match in color and finish and must be non-rusting, non-corroding, and non-staining. Exposed fasteners must be tamper-proof.

2.8 SHOP FABRICATION AND MANUFACTURE

2.8.1 Factory Workmanship

Work must be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled must be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws must be drilled or punched. Drilling and punching must produce clean, true lines and surfaces. Welding to or on structural steel must be in accordance with AWS D1.1/D1.1M. Welding must be continuous along the entire area of contact. Exposed welds must be ground smooth. Exposed surfaces of work must have a smooth finish and exposed riveting must be flush. Fastenings must be concealed where practical. Items specified to be galvanized must be by hot-dip process after fabrication if practical. Galvanization must be in accordance with ASTM A123/A123M and ASTM A653/A653M, as applicable. Other metallic coatings of steel sheet must be in accordance with ASTM A924/A924M. Joints exposed to the weather must be formed to exclude water. Drainage and weep holes must be included as required to prevent condensation buildup.

2.8.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces must be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

2.8.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, must be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete must not be painted. Upon completion of work, damaged surfaces must be recoated.

2.9 COLOR, FINISH, AND CONTRAST

Color must be as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. For buildings required to be handicapped-accessible, the characters and background of signs must be eggshell, matte, or other non-glare finish. Characters and symbols must contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs, plaques, or dimensional letters must be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message must be included. Circuits installed underground must conform to the requirements of Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Steel conduits installed underground and illuminated signage mounted directly on buildings must be in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Signs must be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces must not be installed until finishes on such surfaces have been completed. Submit manufacturer's installation instructions and cleaning instructions.

3.1.1 Anchorage

Anchorage and fastener materials must be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated must include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work must be protected against damage during construction. Hardware and electrical equipment must be adjusted for proper operation. Glass, frames, and other sign surfaces must be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, cover all project identification, directional, and other signs which may mislead the public. Covering must be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Submit 3 copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions must include simplified diagrams for the equipment as installed. Signs must be cleaned, as required, at time of cover removal.

3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames must be field painted in accordance with Section 09 90 00 PAINTS AND COATINGS. Anodized metals, masonry, and glass must be protected from paint. Finish must be free of scratches or other blemishes.

3.3 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces must be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

3.4 Waterfront Signage

Clean, degrease and etch the face of metal panels using methods recommended by the retroreflective sheeting manufacturer. After cleaning and degreasing, apply retroreflective sheeting material to the sign panels as recommended by the manufacturer. Perform shearing, cutting and punching prior to preparing the blanks for application of reflective material. Do not field drill holes in any part of the panel. Use insulating washers between the flat stainless steel washer and sign faces on flat sheet aluminum signs. Replace any damaged sign panels at no additional cost to the Government.

-- End of Section --

SECTION 10 14 00.20

INTERIOR SIGNAGE
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM (2017) Standard And Commentary Accessible
and Usable Buildings and Facilities

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2021) Life Safety Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 Americans with Disabilities Act (ADA)
Accessibility Guidelines for Buildings and
Facilities; Architectural Barriers Act
(ABA) Accessibility Guidelines

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Room Identification And Directional Signage System; G

Stair Signage; G

Building Directories; G

SD-04 Samples

Interior Signage; G

Software; G

Room Identification And Directional Signage System; G

Stair Signage; G

Building Directories; G

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions; G

Protection and Cleaning; G

1.3 EXTRA MATERIALS

Provide 50 paper inserts and two copies of the software for user produced signs and inserts after project completion and equipment necessary for removal of signage parts and pieces.

1.4 QUALITY ASSURANCE

1.4.1 Samples

Submit interior signage samples of each of the following sign types showing typical quality, workmanship and color: all sign types included in project. Approved samples may be installed in the work, provided each sample is identified and location recorded.

1.4.2 Detail Drawings

Submit detail drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, mounting height, shape and thickness of materials, and details of construction. Include a schedule showing the location, each sign type, and message.

1.4.3 Sign Fabricator

Sign Fabricator to follow room number strategies created by designer. The room numbering system to be reviewed and approved by the Contracting Officer and command end users during the shop drawing phase, and prior to fabrication.

1.5 DELIVERY, STORAGE, AND HANDLING

Package materials to prevent damage and deterioration during shipment, handling, storage and installation. Deliver products to the jobsite in manufacturer's original packaging and store in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective interior signage materials and workmanship for a period of 2 years from date of final acceptance of the work.

PART 2 PRODUCTS SG-1

2.1 ROOM IDENTIFICATION AND DIRECTIONAL SIGNAGE SYSTEM

Provide signs, directories, and dimensional building letters that are standard products of manufacturers regularly engaged in the manufacture of such products that essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening. Obtain signage

from a single manufacturer with edges and corners of finished letter forms and graphics true and clean.

2.1.1.1 Modular Sign Systems

Provide manufactured pre-engineered component-based sign system, consisting of a combination of aluminum extrusions and injection molded parts, pre-engineered and designed to create an updatable sign system that allows for easy and inexpensive updates and changes. Provide continuous extruded aluminum interlocking removable endcaps in square thick profile. Copy sign inserts are required to be side loading.

2.1.1.2 Standard Room Signs

Provide signs that include tactile letters, symbols and Braille for interior rooms or spaces where the sign is not likely to change over time. Tactile text descriptions are required for pictograms that are provided to identify a permanent room. Examples include interior signs that label restrooms, stairs, room numbers or letters, and room names. These permanent room signs can include paper inserts for updatable information.

2.1.2.1 Tactile Letters, Symbols and Braille

Provide ADA compliant material per 36 CFR 1191 which is raised 1/32 inch from the first surface, has a minimum 5/8 inch in height and is an ADA acceptable font. The color of the tactile letters is required to contrast with the sign face color per ADA standards. The ADA required Braille has a minimum durometer reading of 90. All raised letters, numbers and symbols are to comply.

2.1.1.3 Directional Signs

Directional signs provide arrows with messages which point to critical destinations such as departments, offices, or other pertinent destinations. These can be a panel sign system with a series of permanently attached messages or a modular system with updatable inserts. Directional signs have header panels with applied or direct print messages.

2.1.1.4 Message Inserts

Provide updatable message inserts covered with a clear matte 0.015 inch vinyl protective overlay. The insert is typeset message laser printed on paper card stock. Provide paper and software with message template for creating text and symbols for computers identified for Government production of paper inserts after project completion. Manufacturer is required to offer online ordering capabilities to facilitate and expedite ordering packages of replacement, color-coated paper inserts. Furnish one suction device to assist in removing face sheet. Provide sliding inserts that slide horizontally exposing different graphic information as identified on the drawings.

2.1.1.5 Type of Mounting for Signs

Provide surface mounted signs with mechanical fasteners. Mount framed plaques with manufacturer's standard (1/6 inch) 1.59 mm thick closed cell vinyl foam with adhesive backing. Adhesive must be transparent, long aging, high tech formulation on two sides of the vinyl foam.

2.1.6 Character Proportions and Heights

Letters and numbers on signs conform to 36 CFR 1191.

2.2 STAIR SIGNAGE

Provide signs on stairs serving three or more stories with special signage within the enclosure at each floor landing conforming to NFPA 101.

Indicate the floor level, the terminus of the top and bottom of the stair enclosure, and the identification of the stair enclosure. Also, state the floor level of, and the direction to, exit discharge. Locate the signage inside the enclosure in a position that is visible when the door is in the open or closed position and install in conformance with 36 CFR 1191.

Provide tactile for floor level designation in accordance with ICC A117.1 COMM.

2.3 BUILDING DIRECTORIES

Provide building directories as lobby directories or floor directories, with a changeable directory listing consisting of the areas, which can include departments, offices, personnel and other destinations located within the facility as well as a map with "you are here" locations. Provide dimensions, details, and materials of sign and message content as indicated on the drawings.

2.3.1 Header Panel

Header panel has acrylic with raised acrylic letters.

2.3.2 Directory Graphics

Provide graphics and text that are first generation from camera ready art.

2.4 MATERIALS

2.4.1 Typeface

Helvetica Regular.

2.5 COLOR, FINISH, AND CONTRAST

Provide color as indicated in drawings; colors listed are not intended to limit the selection of equal colors from other manufacturers. Finish of eggshell, matte, or other non-glare finish for all signs as required in handicapped-accessible buildings.

PART 3 EXECUTION

3.1 INSTALLATION

Install signs plumb and true and in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Submit operating instructions outlining the step-by-step procedures required for system operation. The instructions include simplified diagrams for the system as installed, the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Provide each set permanently bound with a hard cover. The following identification must be inscribed on the covers: "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of

the facility, name of the Contractor, and contract number. Submit in accordance with Section 01 78 23 OPERATING AND MAINTENANCE DATA. Mounting height and mounting location complies with 36 CFR 1191. Install required blocking. Do not install signs on doors or other surfaces until finishes on such surfaces have been installed. Signs installed on glass surfaces are installed with matching blank back-up plates in accordance with manufacturer's instructions.

Do not install items that show visual evidence of biological growth.

3.1.1 Anchorage

Provide anchorage in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown includes slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Provide exposed anchor and fastener materials compatible with metal to which applied with matching color and finish.

- a. Signs mounted to painted gypsum board surfaces must be removable for painting maintenance.
- b. Mount signs to lay-in ceiling grids with clip connections to ceiling tees.
- c. Install signs mounted on metal surfaces with magnetic tape.
- d. Install signs mounted on fabric surfaces with hook and loop tape or pin mount.
- e. Install signs mounted on glass panel surfaces with a white vinyl sign backing.

3.1.2 Protection and Cleaning

Protect the work against damage during construction. Adjust hardware and electrical equipment for proper operation. Clean glass, frames, and other sign surfaces at completion of signage installation in accordance with the manufacturer's written instructions.

-- End of Section --

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SECTION 10 21 13

TOILET COMPARTMENTS
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF45 (2003; Reaffirmed 2009) Designation System
for Aluminum Finishes

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products

ASTM A385/A385M (2020) Standard Practice for Providing
High-Quality Zinc Coatings (Hot-Dip)

ASTM D7611/D7611M (2013; E 2014) Standard Practice for
Coding Plastic Manufactured Articles for
Resin Identification

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM (2017) Standard And Commentary Accessible
and Usable Buildings and Facilities

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003 (Basic) Partitions, Toilet, Complete

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 Americans with Disabilities Act (ADA)
Accessibility Guidelines for Buildings and
Facilities; Architectural Barriers Act
(ABA) Accessibility Guidelines

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

Installation Drawings; G

SD-03 Product Data

Cleaning and Maintenance Instructions

Colors And Finishes

Anchoring Devices and Fasteners

Hardware and Fittings

Brackets

Door Hardware

Toilet Enclosures

Pilaster Shoes

Finishes; G

SD-04 Samples

Colors and Finishes; G

Hardware and Fittings

Anchoring Devices and Fasteners

SD-07 Certificates

Warranty

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

SD-10 Operation and Maintenance Data

Plastic Identification; G

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for toilet compartments.

Provide regional material certifications for applicable materials.

1.2.1.3 IEQ Low-Emitting Materials

For toilet compartments applied inside the weatherproofing system - submit VOC statement indicating compliance with the;

a. VOC Emissions Evaluation.

1.3 CERTIFICATIONS

1.4 REGULATORY REQUIREMENTS

Comply with to ICC A117.1 COMM code for access for the handicapped operation of toilet compartment door and hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the manufacturer's original unopened packages with the brand, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated; free from dust, water, other contaminants, and damage during delivery, storage, and construction.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a period of 15 years from date of final acceptance of the work.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

Provide a complete and usable toilet partition system, including toilet enclosures, room entrance screens, urinal screens, system of panels, hardware, and support components. Furnish the partition system from a single manufacturer, with a standard product as shown in the most recent catalog data. Submit Fabrication Drawings for toilet partitions and urinal screens consisting of fabrication and assembly details to be performed in the factory. Submit manufacturer's Cleaning and Maintenance Instructions in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

2.1.1 Plastic Identification

Verify that plastic products to be incorporated into the project are labeled in accordance with ASTM D7611/D7611M. Where products are not labeled, provide product data indicating polymeric information in the Operation and Maintenance Manual.

Type 2	High Density Polyethylene (HDPE)
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2.2 MATERIALS

2.2.1 Solid Polyethylene Panels (Finish 5)

Provide high density polyethylene (HDPE) suitable for exposed application. Waterproof, non-absorbent and graffiti resistant textured surface with a Flame Spread Index of 75 or less, and a Smoke Developed Index of 450 or less.

2.2.2 Anchoring Devices and Fasteners

Provide steel anchoring devices and fasteners hot-dipped galvanized after fabrication, in conformance with ASTM A385/A385M and ASTM A123/A123M. Conceal all galvanized anchoring devices.

2.2.3 Brackets

Provide two-ear panel wall brackets, T-style, 1 inch stock. Provide stirrup style panel-to-pilaster brackets.

2.2.4 Hardware and Fittings

2.2.4.1 General Requirements

Provide hardware for the toilet partition system that complies with CID A-A-60003 for the specified type and style of partitions. Provide hardware finish highly resistant to alkalis, urine, and other common toilet room acids. Comply with 36 CFR 1191 of latching devices and hinges for handicap compartments; provide chrome-plated steel or stainless steel devices and hinges with door latches that operate without either tight grasping or twisting of the wrist of the operator. Submit three samples of each item, including anchoring devices and fasteners. Approved hardware samples may be installed in the work if properly identified.

2.2.4.2 Finishes

- a. Provide aluminum with clear anodic coating that complies with AA DAF45.
- b. Provide corrosion-resistant steel with a No. 4 finish.
- c. Provide stainless steel with a No. 4 finish.
- d. Provide exposed fasteners that match the hardware and fittings.

2.2.5 Door Hardware

2.2.5.1 Hinges

Provide adjustable hinges to hold in-swinging doors open at any angle up to 90 degrees and outswinging doors up to 10 degrees. Provide self-lubricating hinges with the indicated swing. Provide hinges that are surface-mounted type

2.2.5.2 Latch and Pull

Provide latch and pull that is a combination rubber-faced door strike and keeper equipped with emergency access. Provide surface mounted latch.

2.2.5.3 Coat Hooks

Provide coat hooks that are combination units with hooks and rubber tipped pins.

2.3 PARTITION PANELS AND DOORS

Fabricate partition panels, and pilasters of materials and construction listed:

Provide solid polyethylene toilet partitions and screens with recycled content of 30 percent minimum.

2.3.1 Toilet Enclosures TC-1

Provide toilet enclosures that comply with CID A-A-60003, Type I, Style C, floor anchored/ overhead braced. Furnish width, length, and height of toilet enclosures as shown. Finish surface of panels are solid polyethylene (Finish 5); water resistant; graffiti resistant; non-absorbent radius beveled edges. Reinforce panels indicated to receive toilet paper holders or grab bars for mounting of the items required, and provide cut outs for through partition toilet accessories. Provide grab bars to withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars cannot rotate within their fittings.

2.4 FLOOR-ANCHORED /OVERHEAD BRACED PARTITIONS

Provide pilasters in size indicated that are manufacturer's standard corrosion resistant anchoring assemblies complete with leveling adjustment nuts and pilasters for structural connection to floor. Provide anchoring device at the bottom of the pilaster consisting of a steel bar not less than 1/2 by 7/8 inch welded to the reinforced face sheets and having not less than two 3/8 inch round anchorage devices for securing to the floor slab. Provide anchorage devices complete with threaded rods, expansion shields, lock washers, and leveling-adjustment nuts. Provide shoes at pilasters to conceal anchorage.

Pilasters must be not less than 1-1/4 inch thick with face sheets not less than 0.0393 inch thick. Provide anchoring device at the bottom of the pilaster consisting of a channel-shaped floor stirrup fabricated from not less than 0.0635 inch thick material and a leveling bolt. Secure the stirrup to the pilaster with not less than a 3/16-inch bolt and nut after the pilaster is leveled. Secure the stirrup to the floor with not less than two lead expansion shields and sheetmetal screws. Fabricate overhead brace from a continuous extruded aluminum tube not less than 1 inch wide by 1-1/2 inch high, 0.125-inch wall thickness. Finish must be AA-C22A31 in accordance with AA DAF45. Set and secure brace into the top of each pilaster. Fabricate 3 inch high trim piece at the floor from not less than 0.030 inch thick corrosion-resistant stainless steel.

2.5 PILASTER SHOES

Provide shoes at pilasters to conceal floor-mounted anchorage. Provide one piece molded HDPE pilaster shoes. Height is a minimum 3 inches.

2.6 HARDWARE

Provide hardware for the toilet partition system that complies with

CID A-A-60003 for the specified type and style of partitions. Provide hardware pre-drilled by manufacturer. Use a hardware finish that is highly resistant to alkalis, urine, and other common toilet room acids. Hardware includes: chrome plated nonferrous cast pivot hinges, gravity type, adjustable for door close positioning; nylon bearings; aluminum door latch; door strike and keeper with rubber bumper; and cast alloy chrome plated coat hook and bumper. Provide latching devices and hinges for handicap compartments complying with 36 CFR 1191 and chrome-plated steel door latches that operate without either tight grasping or twisting of the wrist of the operator. Use stainless steel, tamper proof type screws and bolts. Wall mounting brackets are continuous, full height, aluminum, in accordance with toilet compartment manufacturer's instructions. Provide floor-mounted anchorage consisting of corrosion-resistant anchoring assemblies with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor.

2.7 COLORS AND FINISHES

2.7.1 Colors

Provide color as indicated in the drawings; colors listed are not intended to limit the selection of equal colors from other manufacturers.

Color of pilaster shoes matches the core of solid plastic compartments and screens. Submit three samples showing color and a finished edge on two adjacent sides and core construction, each not less than 12 inch square.

2.7.2 Finishes

2.7.2.1 Finishes No. 5

Provide manufacturer's standard solid polyethylene (Finish 5) formed under high pressure rendering a single component section not less than 1 inch thick. Colors extend throughout the panel thickness.

PART 3 EXECUTION

3.1 PREPARATION

Take field measurements prior to the preparation of drawing and fabrication to ensure proper fits. Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work. Verify correct spacing of plumbing fixtures. Verify correct location of built in framing, anchorage, and bracing. Report in writing to Contracting Officer prevailing conditions that adversely affect satisfactory execution of the work of this section. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Do not install items that show visual evidence of biological growth. Install partitions rigid, straight, plumb, and level, with the panels centered between the fixtures. Provide a panel clearance of not more than 1/2 inch and secure the panels to walls and pilasters with continuous full height wall brackets. Locate wall brackets so that holes for wall bolts occur in masonry or tile joints. Secure panels to pilasters with brackets matching the wall brackets. Provide for adjustment due to minor floor variations. Locate head rail joints at pilaster center lines. Install adjacent components for consistency of line and plane. Equip each door

with hinges, one door latch, and one coat hook and bumper. Align hardware to uniform clearance at vertical edges of doors.

- a. Secure panels to ceramic tile on hollow plastered walls or hollow concrete-masonry walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Provide toggle bolts with a load-carrying strength of not less than 600 pounds per anchor.
- b. Secure panels to solid masonry or concrete with lead or brass expansion shields designed for use with not less than 1/4-20 screws, with a shield length of not less than 1-1/2 inches. Provide expansion shields with a load-carrying strength of not less than 600 pounds per anchor.
- c. Submit Installation Drawings for toilet partitions, room entrance screens, and urinal screens showing plans, elevations, details of construction, hardware, reinforcing and blocking, fittings, mountings and escutcheons. Indicate on drawings the type of partition, location, mounting height, cutouts, and reinforcement required for toilet-room accessories.

3.3 OVERHEAD-BRACED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Secure overhead brace to the pilaster face with not less than two fasteners per face. Expansion shields have a minimum 2 inch penetration into the concrete slab. Make tops of doors parallel with the overhead brace when doors are in a closed position.

3.4 FINAL ADJUSTMENT

After completion of the installation, make final adjustments to the pilaster-leveling devices, door hardware, and other working parts of the partition assembly. Doors have a uniform vertical edge clearance of approximately 3/16 inch and rest open at approximately 30 degrees when unlatched.

3.5 CLEANING

Clean all surfaces and adjacent surfaces soiled as a result of the work, in an approved manner compliant with the manufacturer's recommended cleaning and protection from damage procedures until accepted. Remove all equipment, tools, surplus materials, and work debris from the site.

-- End of Section --

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SECTION 10 26 00

WALL AND DOOR PROTECTION
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D256	(2010; R 2018) Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D543	(2020) Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G21	(2015) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use
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SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1545

(2005; R 2021) Instrumental Color
Difference Measurement for Exterior
Finishes, Textiles and Colored Trim

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168

(2017) Adhesive and Sealant Applications

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Corner Guards; G

Wall Covering and Panels; G

SD-03 Product Data

Corner Guards; G

Wall Covering and Panels; G

Recycled content for aluminum component of corner guards; S

Recycled content for steel component of corner guards; S

SD-04 Samples

Corner Guards; G

Wall Covering and Panels; G

SD-06 Test Reports

Fire Resistance Rating

SD-07 Certificates

EPD; S

Recycled Content; S

Regional Material; S

VOC Emissions; S

Indoor air quality for wall covering/panels; S

Indoor air quality for adhesives; S

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for wall/door protection.

Provide regional material certifications for applicable materials.

1.2.1.3 IEQ Low Emitting Materials

For wall systems applied submit statement indicating compliance with the VOC emissions evaluation. For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Keep materials dry, protected from weather and damage, and stored under cover. Store materials at approximately 70 degrees F for at least 48 hours prior to installation.

1.4 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a 1 year period of one year from date of final acceptance of the work.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

To the maximum extent possible, provide wall protection items that are standard products of a single manufacturer and furnished as detailed. Drawings show general configuration of products required, and items differing in minor details from those shown are acceptable.

2.1.1 Resilient Material

Provide resilient material consisting of high impact resistant extruded acrylic vinyl or injection molded thermal plastic conforming to the following:

2.1.1.1 Minimum Impact Resistance

Minimum impact resistance must be 18 ft-lbs/sq. inch when tested in accordance with ASTM D256, (Izod impact, ft-lbs per sq inch notched).

2.1.1.2 Fire Resistance Rating

Provide the following surface burning characteristics when tested and

labeled in accordance with ASTM E84 by a qualified testing agency: maximum flame spread of 25 and a smoke developed rating of 450 or less. Provide material rated as self extinguishing when tested in accordance with ASTM D635. Provide resilient material used for protection on fire rated doors and frames listed by the qualified testing agency performing the tests. Provide resilient material installed on fire rated wood/steel door and frame assemblies tested on similar type assemblies. Test results of material tested on any other combination of door/frame assembly are not acceptable.

2.1.1.3 Integral Color

Provide colored components having integral color and matched in accordance with SAE J1545 to within plus or minus 1.0 on the CIE-LCH scales.

2.1.1.4 Chemical and Stain Resistance

Provide materials resistant to chemicals and stains reagents in accordance with ASTM D543.

2.1.1.5 Fungal and Bacterial Resistance

Provide materials resistant to fungi and bacteria in accordance with ASTM G21, as applicable.

2.2 CORNER GUARDS

2.2.1 Resilient Corner Guards CG-1

Provide as indicated in drawings corner guards, radius formed to profile shown. Provide corner guards that Furnish mounting hardware, cushions, and base plates. Provide assembly consisting of a snap-on corner guard formed from high impact resistant resilient material, mounted on a continuous aluminum retainer. Extruded aluminum retainer conforms to ASTM B221, alloy 6063, temper T5 or T6. Provide aluminum components that contain a minimum of 35 percent recycled content. Provide data identifying percentage of recycled content for aluminum component of corner guards. Flush mounted type guards act as a stop for adjacent wall finish material. Provide flush mounted corner guards installed in fire rated wall that maintain the rating of the wall. Manufacturer to provide insulating materials that are an integral part of the corner guard system. Provide exposed metal portions of fire rated assemblies with a paintable surface.

2.2.2 Stainless Steel Corner Guards CG-2

Provide stainless steel base material that contains a minimum of 60 percent recycled content. Provide data identifying percentage of recycled content for steel component of corner guards. Fabricate stainless steel base material of 16 gauge thick material conforming to ASTM A167, type 430 or 304. Provide corner guards as indicated in the drawings.

2.3 WALL COVERING AND PANELS FRP-1

Provide wall covering and panels consisting of fiberglass reinforced plastic. Panel sizes are 4 by 8 feet. Provide wall covering material used on the interior of the building (defined as inside of the weatherproofing system) that meets either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom

spaces regardless of space type) the VOC content requirements of SCAQMD Rule 1168, or VOC content requirements of GS-36. Provide certification of indoor air quality for wall covering/panels.

2.3.1 Trim, Fasteners And Anchors

Provide vinyl trim, fasteners and anchors for each specific installation as indicated.

2.3.2 Finish

Submit samples indicating color and texture of materials requiring color and finish.

2.3.3 Resilient Material Finish

Provide resilient material finish of embossed texture with colors in accordance with SAE J1545.

2.4 ADHESIVES

Provide adhesive for resilient material in accordance with manufacturers recommendations. Provide sealants and non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) the VOC content requirements of SCAQMD Rule 1168, or VOC content requirements of GS-36. Provide certification of indoor air quality for adhesives.

2.5 COLOR

Provide color as indicated in the drawings; colors listed are not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install items that show visual evidence of biological growth. Install items on surfaces that are clean, smooth, and free of obstructions.

3.1.1 Corner Guards

- a. Mount guards as indicated in the drawings and in accordance with manufacturer's written installation instructions.

3.1.1.1 Stainless Steel Guards

- a. Mount guards as indicated in the drawings and in accordance with manufacturer's recommendations.

3.1.2 Wall Coverings and Panels

Install as indicated in accordance with manufacturer's written instructions.

-- End of Section --

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SECTION 10 28 13

TOILET ACCESSORIES
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C1036 (2016) Standard Specification for Flat Glass

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-1691 (1994; Rev F) Construction and Material Schedule for Military Medical and Dental Facilities

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Product Schedule; G

Submit product Schedule indicating types, quantities, sizes, and installation locations by room for each toilet accessory item required. Identify locations using room designations indicated on the drawings.

SD-03 Product Data

Recycled content for stainless steel toilet accessories; S

FSS-1 Bench, Stall, Shower, Built-In; G

SND-1 Disposal, Sanitary Napkin, SS, Surface Mounted; G

GB-1 Grab Bar, 1-1/4 inch Diameter, SS, 2 Wall, W/C Accessible; G

GB-1 Grab Bar, 1-1/4 inch Diameter, SS, 2 Wall, Shower Use; G

Shelf, Utility W/ Mop/Broom Holders, SS, Surface Mounted; G

TP-1 Hook, Towel, Double, SS, Surface Mounted; G

SCR-1 Rod, Shower; G

TTD-1 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mounted; G

SD-1 Automatic Soap Dispenser; G

PTD/WR-1 Automatic Dispenser, Paper Towel, and Waste Receptacle, SS,
Surface Mounted; G

PTD/WR-2 Automatic Dispenser, Paper Towel, And Waste Receptacle, SS,
Recessed; G

MG-1 Mirrors

Submit catalog numbers, literature, data sheets, construction details, profiles, anchoring and mounting requirements ,including cutouts in other work and substrate preparation,electrical characteristics, and other pertinent data for each toilet accessory item to evaluate function, materials, dimensions and appearance.

SD-07 Certificates

EPD; S

Recycled Content; S

Regional Material; S

SD-10 Operation and Maintenance Data

SD-1 Automatic Soap Dispenser; G

PTD/WR-1 Automatic Dispenser, Paper Towel, And Waste Receptacle, SS,
Surface Mounted; G

PTD/WR-2 Automatic Dispenser, Paper Towel, And Waste Receptacle, SS,
Recessed; G

Submit Data Package 1 for each toilet accessory item , and Data Package 2 for each electrical toilet accessory item, in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for toilet accessories.

Provide regional material certifications for applicable materials.

1.4 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

1.5 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a period of one year from date of final acceptance of the work.

PART 2 PRODUCTS

2.1 ACCESSORY ITEMS

Provide toilet accessories where indicated in accordance with Contractor-provided product schedule. Conform to the requirements for accessory items specified herein which are based on MIL-STD-1691 Joint Schedule Numbers (JSN). Provide each accessory item complete with the necessary mounting plates of sturdy construction with corrosion resistant surface.

Provide stainless steel products listed herein manufactured from materials containing a minimum of 50 percent recycled content. Provide data identifying percentage of recycled content for stainless steel toilet accessories.

2.1.1 Anchors and Fasteners

Provide corrosion-resistant anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide tamperproof design exposed fasteners with finish to match the accessory. Provide fasteners proposed for use for each type of wall construction and mounting.

2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

Metal	Finish
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

2.1.3 Bench, Stall, Shower, Built-In (FSS-1)

Wall mounted shower seat. Frame made of 18 gauge stainless steel with satin finish. Seat made of one piece of 1/2 inch thick nonporous solid phenolic with slots to permit water to drain, secured to frame with stainless steel carriage bolts and acorn nuts. Mounting hardware included. Seat to support a minimum static load of 250 pounds. Hinge seat to fold up when not in use. Seat complies with ADA guidelines.

Approximate size: 34 inches wide by 22 inches deep by 1/2 inch thick.

2.1.4 Automatic Soap Dispenser (SD-1)

Provide automatic (hands free) surface mounted vertical soap dispenser consisting of welded stainless steel with a satin finish and clear acrylic refill indicator window and key lock. Refillable plastic soap container to have a holding capacity of 27 fluid ounces. Valve to be corrosion-resistant, no-touch, sensor activated type suitable for foam soap. Unit is ADA compliant.

2.1.5 Combination Automatic Dispenser, Paper Towel, and Waste Receptacle, SS, Recessed ((PTD/WR-1) and Surface Mounted (PTD/WR-2))

Combination automatic paper towel dispenser and waste receptacle. Unit constructed of heavy gauge stainless steel with a satin finish, welded construction, full length piano hinge and tumbler lock. Automatic dispenser to accept standard-core 8 inch wide x 8 inch diameter x 800 foot long towel roll. Waste receptacle capacity to be 12 gallons. Unit is ADA compliant.

Approximate size: 17.5 inches wide by 56 inches tall by 9 inches deep.

2.1.6 Disposal, Sanitary Napkin, SS, Surface Mounted (SND-1)

Surface mounted sanitary napkin receptacle. Unit made of stainless steel with satin finish and all welded construction. Unit has piano hinge attached at the top and an integral finger depression for opening. For use with disposable paper liners, available separately. Unit may be attached to wall or toilet partition.

Approximate size: 7 inches wide by 4 inches deep by 10 inches high.

2.1.7 Grab Bar, 1-1/4 Inch Diameter, SS, 2 Wall, W/C Accessible (GB-1)

Grab bar of 1-1/4 inch diameter satin finish stainless steel with peened gripping surface for use in toilet stall/room. Snap-on flange covers for concealed mounting are stainless steel and equipped with two screw holes for attachment to wall. Grab bars designed to meet and exceed ADA requirements for structural strength. Grab bars designed to withstand loads of 900 pounds when properly installed. Clearance from wall to grab bar is 1-1/2 inches to meet ADA and ANSI codes.

2.1.8 Grab Bar, 1-1/4 Inch Diameter, SS, 2 Wall, Shower Use(GB-1)

Grab bar of 1-1/4 inch diameter satin finish stainless steel with peened gripping surface. Snap-on flange covers for concealed mounting stainless steel. Bent ends of tubing pass through the flanges and are Heliarc welded for maximum strength. Grab bars designed to meet and exceed ADA requirements for structural strength. Grab bars designed to withstand loads of 900 pounds when properly installed. Clearance from wall to grab bar is 1-1/2 inches to meet ADA and ANSI codes.

2.1.9 Shelf, Utility W/ Mop/Broom Holders, SS, Surface Mounted (as indicated in JAN rm 223)

Surface mounted mop/broom holder with shelf made of 18 gauge stainless steel with all exposed surfaces in satin finish. Unit has shelf 8 inches deep with shelf support brackets of satin finish stainless steel welded to mounting base, and a minimum of 3 hooks/3 holders. Mop holders have

spring-loaded rubber cams and hold mop or broom handle with a diameter between 5/8 inch and 1 inch.

Approximate size: 36 inches wide by 8 inches deep.

2.1.10 Hook, Towel, Double, SS, Surface Mounted (TP-1)

Surface mounted double garment hook made of stainless steel with satin finish. For use on door back or wall. Hook comes with concealed mounting bracket secured to concealed wall plate. Mounting hardware included. Flange size is approximately 2 inches by 2 inches.

2.1.11 Rod, Shower (SCR-1)

Shower Curtain Rod with concealed mounting. Shower curtain rod made of satin finish stainless steel, 1 inch diameter, with flanges included. Length as indicated on drawings.

2.1.12 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mounted (TTD-1)

Concealed surface mounted, double roll, toilet tissue dispenser of stainless steel. Unit holds and dispenses two standard 5-1/4 inch diameter rolls of toilet tissue. Spindles are free-spinning for non-controlled delivery, chrome-plated plastic equipped with heavy-duty internal springs.

Approximate size: 7 inches diameter by 4 inches deep.

2.1.13 Mirrors (MG-1)

Provide Type I transparent flat type, Class 1-clear glass for mirrors. Glazing Quality q1 1/4 inch thick conforming to ASTM C1036. Coat glass on one surface with silver coating, copper protective coating, and mirror backing paint. Provide highly adhesive pure silver coating of a thickness which provides reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, free of pinholes or other defects. Provide copper protective coating with pure bright reflective copper, homogeneous without sludge, pinholes or other defects, of proper thickness to prevent "adhesion pull" by mirror backing paint. Provide mirror backing paint with two coats of special scratch and abrasion-resistant paint and baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.1.13.1 Mastic

Mastic for setting mirrors shall be a polymer type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Mastic shall be compatible with mirror backing paint, and shall be approved by mirror manufacturer.

2.1.13.2 Mirror Frames

Mirrors shall be provided with mirror frames (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall. Frames shall be 1-1/4 by 1/4 inch continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material shall be provided with mirror frames.

2.1.13.3 Mirror Clips

Concealed fasteners of type to suit wall construction material shall be provided with clips.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install items that show visual evidence of biological growth. Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Use sealants for brackets, plates, anchoring devices and similar items in showers (a silicone sealant specified in Section 07 92 00 JOINT SEALANTS) as they are set to provide a watertight installation. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal fasteners on accessories without backplates. Install accessories with corrosion-resistant fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs, or to backplates secured to metal studs.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

-- End of Section --

SECTION 10 44 16

FIRE EXTINGUISHERS

11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E814 (2013a; R 2017) Standard Test Method for
Fire Tests of Penetration Firestop Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Cabinets; G

Wall Brackets; G

Schedule; G

SD-03 Product Data

Cabinets; G

Wall Brackets; G

Replacement Parts List

1.3 DELIVERY, STORAGE, AND HANDLING

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in their original packages, containers, or bundles bearing the brand name and the name and type of the material.

1.4 PROJECT SCHEDULE

Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

PART 2 PRODUCTS

Submit fabrication drawings consisting of fabrication and assembly details performed in the factory and product data for the following items:
Accessories, cabinets, Wall Brackets.

2.1 EQUIPMENT

2.1.1 Cabinets

2.1.1.1 Material

Provide aluminum cabinets.

2.1.1.2 Type

Provide types as indicated on the life safety drawings.

Provide a fire rated cabinet, listed and labeled to comply with ASTM E814 for fire resistance wall rating.

2.1.1.3 Size

Dimension cabinets to accommodate the fire extinguishers provided as part of the FF&E package.

2.1.2 Wall Brackets

Provide wall-hook fire extinguisher wall brackets.

Provide wall bracket and accessories as approved.

2.1.2.1 Identification

Provide Fire Extinguisher identification at all locations as indicated by the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Install fire extinguisher cabinets or wall brackets in locations indicated in drawings and in compliance with requirements of authorities having jurisdiction.

Comply with the manufacturer's recommendations for all installations.

3.2 PROTECTION

3.2.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new work at no additional cost to the Government.

Submit replacement parts list indicating specified items replacement part, replacement cost, and name, address and contact for replacement parts distributor.

3.2.2 Cleaning

Clean all surfaces of the work, and adjacent surfaces which are soiled as a result of the work. Remove from the site all construction equipment, tools, surplus materials and rubbish resulting from the work.

-- End of Section --

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SECTION 10 51 13

BENCHES

05/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-L-00486

(Rev J) Lockers, Clothing, Steel

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Types; G

Location; G

Installation

SD-03 Product Data

Material

SD-04 Samples

Color chips; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

1.3 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this

product has an EPD complying with LEED v4.1 requirements.

1.3.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for benches.

Provide regional material certifications for applicable materials.

1.4 DELIVERY, HANDLING, AND STORAGE

Deliver lockers and associated materials in their original packages, containers, or bundles bearing the manufacturer's name and the name of the material. Protect from weather, soil, and damage during delivery, storage, and construction.

1.5 FIELD MEASUREMENTS

To ensure proper fits, make field measurements prior to the preparation of drawings and fabrication. Verify correct location

1.6 QUALITY ASSURANCE

1.6.1 Color Chips

Provide a minimum of three color chips, not less than 3 inches square, of each color scheduled.

Government may request performance-characteristic tests on assembled lockers. Tests and results must conform to FS AA-L-00486. Lockers not conforming will be rejected.

PART 2 PRODUCTS

2.1 TYPES

2.1.1 Benches (BH-1)

HDPE plastic benches with aluminum pedestals anchored to the floor.

2.2 MATERIAL

2.2.1 Finish

2.2.1.1 Tops

Bench tops shall be constructed of HDPE plastic, color as indicated on drawings. Tops shall be 1-1/2 inches thick with all edges rounded to a 1/4 inch radius. Standard bench top size is 20 inches wide by 48 inches long. Where installed in wet locations, the surface of the seat shall be slip resistant and shall not accumulate water.

2.2.1.2 Pedestals

Aluminum pedestals shall be 16 inches high, and secured to bench tops with stainless steel tamper resistant screws and secured to the floor using lead expansion shields with 2 inches stainless steel Phillips head machine bolts. Pedestals shall withstand 250 pounds applied at any point of the seat or supporting structure.

PART 3 EXECUTION

3.1 ASSEMBLY AND INSTALLATION

Assemble benches according to the benches manufacturer's instructions. Secure benches and base with screws as indicated. Bench shall be 2-1/2 inches maximum off the wall from rear edge of the seat.

3.2 FIELD QUALITY CONTROL

3.2.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

3.2.2 Cleaning

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner. Remove equipment, surplus materials, and rubbish from the site.

-- End of Section --

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SECTION 10 56 13

STEEL SHELVING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

MATERIAL HANDLING INDUSTRY OF AMERICA (MHI)

MHI MH28.1 (1997) Specification: Industrial Steel
Grade Shelving

1.2 DEFINITIONS

For the purposes of this specification the shelf category, "heavy weight," will be as follows. Load is given per shelf in pounds for evenly distributed load. This does not limit the shelf size, only the shelving category.

Minimum Evenly Distributed Load Per Shelf in Pounds		
Shelf Size		Type Heavy Duty
5 by 8 ft.		3000

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shelving Units

SD-03 Product Data

Shelving Units

Installation instructions

SD-04 Samples

Finish

SD-06 Test Reports

Shelving Units

Finish

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

1.4 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.4.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.4.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for steel shelving system.

Provide regional material certifications for applicable materials.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in original packages, containers or bundles bearing the brand name and identification of the manufacturer. Store inside under cover. Protect surfaces from damage.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

MHI MH28.1. Provide pallet rack shelving units indicated. Provide shelving units designed for full dead and live load, designated heavy duty. Provide units with base plates for floor anchorage, min 4 supports per 5 foot x 9 foot shelf. Provide floor and wall and adjacent unit anchorages for units in Seismic design category B.

2.2 FINISH

Provide the shelving units in the manufacturer's standard colors as chosen by the Contracting Officer. Clean metal by multiple stage phosphatizing and sealing process, for rust resistance and paint adhesion. Provide electrostatically applied enamel finish coats, baked hard for a minimum of 30 minutes at 300 degrees F.

2.3 SOURCE QUALITY CONTROL

- a. MHI MH28.1, for tests of shelf capacity, lateral stability and shelf connections.

PART 3 EXECUTION

3.1 EXAMINATION

Before installation, examine shelving units for dents and scratches.
Replace damaged shelving.

3.2 INSTALLATION

Install shelving according to manufacturer's installation instructions.
Make floor connections as indicated in this specification.

3.3 PROTECTION

Cover and protect shelving from damage during the completion of
construction. Remove prior to acceptance of project.

3.4 SCHEDULE

SHELVING						
Type	Width	Depth	Number of Shelves	Height	Accessories	Room
A	8 feet-0 inches	5 feet-0 inches	2 at 2 feet and 6 feet AFF	8 feet-0 inches	N/A	Ship Stor 123

-- End of Section --

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SECTION 11 11 37

ELECTRIC VEHICLE SUPPLY EQUIPMENT
11/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 62 (2018) UL Standard for Safety Flexible
Cords and Cables

UL 2202 (2012; Reprint Feb 2018) UL Standard for
Safety Electric Vehicle (EV) Charging
System Equipment

UL 2231-1 (2012; Reprint Aug 2016) UL Standard for
Safety Personnel Protection Systems for
Electric Vehicle (EV) Supply Circuits:
General Requirements

UL 2231-2 (2012; Reprint Aug 2016) UL Standard for
Safety Personnel Protection Systems for
Electrical Vehicle (EV) Supply Circuits:
Particular Requirements for Protection
Devices for Use in Charging Systems

UL 2251 (2017) UL Standard for Safety Plugs,
Receptacles and Couplers for Electric
Vehicles

UL 2594 (2016) UL Standard for Safety Electric
Vehicle Supply Equipment

1.2 DEFINITIONS

1.2.1 ELECTRIC VEHICLE SUPPLY EQUIPMENT

Electric Vehicle Supply Equipment (EVSE), also referred to as "charging stations," encompasses the conductors, including the ungrounded, grounded, and equipment grounding conductors and the electric vehicle connectors,

attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of delivering energy from the premises wiring to the electric vehicle (EV). There are three types of EVSE:

- a. Level 1 - Refers to a freestanding or wall mounted charging device that delivers a 110/120V charge, replenishing an EV battery at a rate of 4 to 6 miles of range per hour of charging time. Charging an EV at Level 1 typically takes between 7 and 20 hours depending on the size of the vehicle's battery.
- b. Level 2 - Refers to a freestanding or wall mounted charging device capable of being networked that delivers a 208/240V charge, replenishing an EV battery at a rate of 10 to 20 miles of range per hour of charging time. Charging an EV at Level 1 typically takes between 2 and 5 hours depending on the size of the vehicle's battery.
- c. Direct Current (DC) Fast Charging, a freestanding or wall mounted device capable of being networked that is designed to charge vehicles more quickly than Level 1 or Level 2 with an electrical output ranging between 40 kW - 120 kW delivering a charge of up to 480V. DC Fast Charging can typically replenish an EV battery at a rate of 50 to 90 miles of range per 30 minutes of charging time.

1.2.2 Certified Installers

Installers must be certified by EVSE manufacturer or a recognized certified training agency.

1.3 RELATED REQUIREMENTS

Materials not considered to be Electric Vehicle Supply Equipment or accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION, Section 32 17 23 PAVEMENT MARKINGS and Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section with the additions and modifications specified herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

In addition, submit in accordance with paragraph COORDINATED SUBMITTAL REVIEWS herein.

SD-02 Shop Drawings

Cords; G

Level 2 Pedestal Mounted EVSE; G

SD-03 Product Data

Cords; G

Level 2 Pedestal Mounted EVSE; G

SD-07 Certificates

Qualifications; G

Certified Installers; G

SD-08 Manufacturer's Instructions

Cords; G

Level 2 Pedestal Mounted EVSE; G

SD-09 Manufacturer's Field Reports

Testing of Electric Vehicle Supply Equipment; G

SD-10 Operation and Maintenance Data

Electric Vehicle Supply Equipment, Data Package 3

SD-11 Closeout Submittals

OMSI Warranty; G

Record Documentation

1.5 MAINTENANCE MATERIAL SUBMITTALS

Provide a list of manufacturer recommended maintenance items required for EVSE Operation.

1.5.1 Operation and Maintenance Manuals

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit two manuals and electronic file at least 2 weeks prior to field training.

1.6 QUALITY CONTROL

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials

under comparable circumstances and of similar size.

- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.2.1 Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Provide products manufactured within 2 years prior to date of delivery to site. As a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70 for all materials, equipment, and devices.

1.6.2.3 EVSE Installers

Submit documentation certifying that pertinent personnel are qualified for EVSE installation. The documentation must include installation experience on two projects of comparable size and scope of work.

1.7 WARRANTY

Provide equipment items supported by service organizations that are convenient to the equipment installation in order to render satisfactory service to the equipment within 24 hours of notification during the warranty period of the contract.

Provide warranty for Materials and Workmanship of EVSE: Two years.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Provide products and materials not considered to be ELECTRIC VEHICLE SUPPLY EQUIPMENT and related accessories for power requirements as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.2 ELECTRIC VEHICLE SUPPLY EQUIPMENT

2.2.1 System Description

Electric Vehicle Supply Equipment capable of charging multiple vehicles at Level 2.

2.2.2 Level 2 EVSE

2.2.2.1 Level 2 Pedestal Mounted EVSE

UL 2202, UL 2251, UL 2231-1, UL 2231-2, UL 2594. Type 2, SAE J1772 connector, 208 volt, input 30 amps, output 30 amps, 7.2 kW.

2.2.3 Cords

UL 62.

- a. 14 feet, minimum, UL rated charging cords with integral retractable cord management mechanism or separate cord management.

2.3 CONNECTOR HOLSTER DOCK

Provide connector holster dock to store charger plugs when not in use. Holster construction consist of high strength injection molded plastic with temperature ratings of minus 30 deg C to 50 deg C. Provide holster to match EV plug.

2.4 PEDESTAL CONSTRUCTION

Provide corrosion resistant construction for outdoor use and continuous exposure to a marine environment. Pedestal shall be NEMA 4x Construction.

2.5 CAST-IN-PLACE CONCRETE

Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. All concrete shall conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.6 MANUFACTURER'S NAMEPLATES

Each item of equipment shall have a nameplate bearing, as a minimum, the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable. Include additional information as applicable to fully identify the equipment. Nameplates shall be made of noncorrosive metal.

2.7 PAVEMENT MARKINGS

Provide pavement markings for the vehicle charging parking spots to indicate the restrictions for electrical vehicle parking.

2.8 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE) SIGNAGE

Provide signage Electric Vehicle Supply Equipment per MUTCD and Base standards.

2.9 WHEEL STOPS AND BOLLARDS

Provide wheel stops or bollards in Electrical Vehicle parking spaces to provide protection for Electric Vehicle Supply Equipment.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

- a. The EVSE installer must be certified by the manufacturer or a recognized training facility to perform the installation.
- b. Provide chargers per manufacturer instructions and recommendations. EVSE must be programmed and configured by a certified installer.

3.2 GROUNDING

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 25 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.3 FIELD APPLIED PAINTING

Where field applied painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.5.1 Exterior Location

Mount on concrete slab, unless otherwise indicated. The slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above the finished grade. Edges above grade shall have 1/2 inch chamfer. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter. Cut off and bush conduits 3 inches above slab surface.

3.6 OPERATION AND MAINTENANCE

3.6.1 Operation and Maintenance Training

Conduct a training course for the members of the operating staff as designated by the Contracting Officer. Make the training period consist of a total of 4, hours for Level 1 or level 2 normal working time and start it after all work specified herein is functionally completed and the Performance Tests have been approved. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed On-site Training Materials and schedule concurrently with the Operation and Maintenance Manuals and at least 30 days prior to conducting the training course.

3.7 RECORD DOCUMENTATION

Provide drawings indicating construction provided for this project.
Provide electronic files and hard copies on 11 inch by 17 inch paper.

3.8 FIELD QUALITY CONTROL

3.8.1 Testing of Electric Vehicle Supply Equipment

Provide testing of Electric Vehicle Supply Equipment with test equipment per current standards and manufacturers recommendations. Provide data submittal indicating time of charge and kW level used.

3.8.2 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests.
Submit reports, including acceptance criteria.

3.8.2.1 EVSE

a. Visual and mechanical inspection.

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition. Check for damage.
- (3) Inspect anchorage, alignment, and grounding.
- (4) Perform specific inspections and mechanical tests as recommended by manufacturer.

b. Electrical Tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.
- (2) Verify voltage levels.
- (3) Check ground fault circuit interrupt.
- (4) Check pilot signal detection and verification.

(5) Verify current limit.

(6) Verify operation of alarms.

(7) Verify EVSE Electronic Data Interface.

Values of test shall be within limits of manufacturer's recommendations.

-- End of Section --

SECTION 12 24 13

ROLLER WINDOW SHADES
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/WCMA A100.1 (2018) American National Standard for
Safety of Window Covering Products

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701 (2019) Standard Methods of Fire Tests for
Flame Propagation of Textiles and Films

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES

SD-02 Shop Drawings

Detailed Drawings; G

SD-03 Product Data

Window Shades; G

SD-04 Samples

Window Shades; G

SD-06 Test Reports

Flammability Requirements; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

Qualifications

SD-10 Operation and Maintenance Data

Window Shades, Data Package 1; G

1.2.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.2.1.1 M&R Environmental Product Declaration (EPD)

Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.2.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for window treatments.

Provide regional material certifications for applicable materials.

1.2.1.3 IEQ Low-Emitting Materials

For window treatments applied inside the weatherproofing system - submit VOC statement indicating compliance with the;

a. VOC Emissions Evaluation.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

1.3.1.1 Installer's Qualifications

Installer trained and certified by the manufacturer with a minimum of ten years of experience in installing products comparable to those specified in this section.

1.3.2 Flammability Requirements

Passes in accordance with NFPA 701 small and large-scale vertical burn. Materials tested are identical to products proposed for use.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated and free from dust, water, or other contaminants and has easy access for inspection and handling. Store materials flat in a clean dry area with temperature maintained above 50 degrees F. Do not open containers until needed for installation unless verification inspection is required. Handle and store shades in accordance with manufacturer's recommendations.

1.5 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a period of 10 years from date of final acceptance of

the work.

PART 2 PRODUCTS

2.1 WINDOW SHADES RS-1

Provide roller tube that operates smoothly and of sufficient diameter and thickness to prevent excessive deflection. Provide brackets that are appropriate for inside mount. Provide shade cloth meeting the performance described in NFPA 701, small scale test. Treat steel features for corrosion resistance.

Provide certification of indoor air quality for roller window shades.

2.1.1 Manually Operated Shades with Single Rollers

2.1.1.1 Chain-and-Clutch Operating Mechanisms

Provide continuous-loop bead chain and clutch that stops shade movement when bead chain is released; shade to be permanently adjusted and lubricated.

2.1.1.2 Bead Chains

Provide bead chain from #10 stainless steel rated to 90 lb. minimum breaking strength with pull chain tensioning device complying with ANSI/WCMA A100.1

- a. Loop Length: Full length of roller shade.
- b. Limit Stops: Allows shade to stop when chain is released. Provide limit stops to prevent shade from being raised or lowered too far.
- c. Chain-Retainer Type: Chain tensioner, jamb mounted.

2.1.1.3 Rollers

Provide corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shade bands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shade cloth for service.

- a. Roller Drive-End Location: Right side of interior face of shade.
- b. Direction of Shade cloth Roll: Regular, from back (exterior face) of roller.
- c. Shade cloth-to-Roller Attachment: Manufacturer's standard method. Adhesive attachment is not acceptable.

2.1.1.4 Mounting Hardware

Provide corrosion resistant brackets or endcaps compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated. Provide hardware that allows for field adjustment or removal of shade roller tube and other operable hardware component without removal of brackets and end or center supports.

2.1.1.5 Shade Cloth

- a. Shade Material: As indicated in drawings.
- b. Shade Cloth Bottom (Hem) Bar: Steel or extruded aluminum. Provide shade bar enclosed in sealed pocket of shade band material.

2.1.1.6 Installation Accessories

- a. Front Fascia: L-shaped aluminum extrusion to conceal shade roller and hardware that snaps onto end caps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands. Provide manufacturers standard height fascia as required to conceal roller and shade band assembly when shade is fully open.

2.2 COLOR

Provide color, pattern and texture for metal trim and shade fabric as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS

After becoming familiar with details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Provide roller window shades, complete with necessary brackets, fittings, and hardware as indicated.

Perform installation in accordance with the approved detailed drawings and manufacturer's installation instructions. Install units level, plumb, secure, and at proper height and location relative to window units. Provide and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Do not start installation until completion of room painting and finishing operations.

3.3 CLEAN-UP

Upon completion of the installation, clean window treatments and exposed components as recommended by manufacturer. Adjust window treatment for form and appearance and proper operating condition. Repair or replace damaged units as directed by the Contracting Officer. Isolate metal parts from direct contact with concrete, mortar, or dissimilar metals. Ensure shades installed in recessed pockets can be removed without disturbing the pocket. The entire shade, when retracted, is contained inside the pocket. For shades installed outside the jambs and mullions, overlap each jamb and mullion 0.75 inch or more when the jamb and mullion sizes permit. Include all hardware, brackets, anchors, fasteners, and accessories necessary for a complete, finished installation.

NOAA OMAO Ship & Support Facility Relocation
NSN-Newport, Rhode Island

Work Order No. 1562331

-- End of Section --

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SECTION 12 48 13

ENTRANCE FLOOR MATS AND FRAMES

08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D2047 (2017) Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine

ASTM E648 (2019a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

1.2 SUSTAINABILITY REPORTING

Materials in this technical specification may increase contract compliance with sustainability requirements.

1.2.1 EPA Comprehensive Procurement Guidelines

See Section 01 33 29 SUSTAINABILITY REPORTING for requirements associated with EPA-designated products.

1.2.2 USDA Biobased

See Section 01 33 29 SUSTAINABILITY REPORTING for requirements associated with USDA Biobased products.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings; G

Detail Drawings; G

SD-03 Product Data

Entrance Floor Mats and Frames; G

Adhesives and Concrete Primers; G

SD-04 Samples

Entrance Floor Mats and Frames; G

SD-07 Certificates

EPD(s); S

Recycled Content; S

Regional Material; S

VOC Emissions; S

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-10 Operation and Maintenance Data

Protection, Maintenance, and Repair Information

1.3.1 LEED Submittal Requirements

Submit individual credit documentation in accordance with Section 01 33 29 requirements.

1.3.1.1 M&R Environmental Product Declaration (EPD)

)Submit product data or other published information verifying that this product has an EPD complying with LEED v4.1 requirements.

1.3.1.2 M&R Sourcing of Raw Materials

Provide recycled content certifications for flooring system.

Provide regional material certifications for applicable materials.

1.3.1.3 IEQ Low Emitting Materials

For Flooring systems applied - submit statement indicating compliance with the;

a. VOC Emissions Evaluation.

For Adhesives and Sealants applied on site refer to specification section 07 92 00 for low-emitting requirements.

1.4 QUALITY CONTROL

Comply with 36 CFR 1191 Americans with Disabilities Act (ADA)
Accessibility Guidelines for Buildings and Facilities; Architectural

Barriers Act (ABA) Accessibility Guidelines for installed entrance floor mats and frames. Ensure that entrance floor mats and frames are slip-resistant in accordance with ASTM D2047, with a minimum 0.60 coefficient of friction, for accessible routes and are structurally capable of withstanding a wheel load of 350 lb/wheel. Ensure that flammability is in accordance with ASTM E648, Class 1, Critical Radiant Flux, minimum 0.45 watts/square meter.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in their original packages or containers bearing labels clearly identifying the manufacturer, brand name, and quality or grade.

Store materials in their original unbroken packages or containers in the area in which they will be installed. Unwrap, inspect, and place mats at indicated locations. Remove all excess packing materials.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

2.1.1 Entrance Floor Mats and Frames WOM-1

Submit the manufacturer's catalog data. Submit samples of assembled sections of floor mats showing corners, intersections, and other details of construction. Submit samples of custom graphics, exposed floor mats, frame finishes and accessories.

2.1.1.1 Frames

Provide 1/4 inch surface-mounted frames that have a tapered aluminum alloy edge. Frame color is mill finish. Frame to have slots providing free area for fall through of dirt and debris. Ensure that edge-frame members are fabricated in single lengths or with the fewest pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins. Ensure that any concealed surfaces of aluminum frames that contact cementous material are coated with the manufacturer's standard protective coating. Ensure that frames include accessories and devices required for a complete installation.

2.1.1.2 Tread Insert Options

Provide tread inserts consisting of carpet composed of solution-dyed nylon. Ensure that pile weight is a minimum 30 ounces per square yard , carpet/bristle filament mix.

2.1.2 Adhesives and Concrete Primers

Provide adhesives and concrete primers, where required, according to the manufacturer's recommendations.

2.1.3 Color and Size

Ensure that color is in accordance with the drawings. Ensure that the size of mat is as indicated in the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

Comply with the manufacturer's requirements for substrates and floor conditions affecting installation of floor mats and frames. Ensure that all unsatisfactory conditions have been corrected before installation.

3.2 INSTALLATION

Submit detail drawings, and custom graphics drawings as required. Provide installation drawings. Provide the manufacturer's protection, maintenance, and repair information.

Install floor mats and frames according to manufacturer's instructions. Set mat tops at the height recommended by the manufacturer for the most effective cleaning action. Provide clearance between bottoms of doors and tops of mats.

-- End of Section --

SECTION 12 93 00

SITE FURNISHINGS

08/17, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303 (2016) Code of Standard Practice for Steel Buildings and Bridges

AISC 360 (2016) Specification for Structural Steel Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)

ASME B18.2.2 (2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

ASME B18.6.2 (2020) Square Head Set Screws and Slotted Headless Set Screws (Inch Series)

ASME B18.6.3 (2013; R 2017) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

ASME B18.21.1 (2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.3 (2020) Safety Requirements for Powder-Actuated Fastening Systems American National Standard for Construction and Demolition Operations

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A500/A500M	(2021) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501/A501M	(2014) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B108/B108M	(2019) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2020) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM C94/C94M	(2020) Standard Specification for Ready-Mixed Concrete
ASTM C150/C150M	(2020) Standard Specification for Portland Cement
ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base

Emulsions for Use as Protective Coatings
for Metal

ASTM D3451 (2006; R 2017) Standard Guide for Testing
Coating Powders and Powder Coatings

ASTM E488/E488M (2015) Standard Test Methods for Strength
of Anchors in Concrete and Masonry Elements

ASTM F1487 (2017) Standard Consumer Safety
Performance Specification for Playground
Equipment for Public Use

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25 (1997; E 2004) Zinc Oxide, Alkyd, Linseed
Oil Primer for Use Over Hand Cleaned
Steel, Type I and Type II

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1925 (Rev A; Notice 3) Shield Expansion (Nail
Anchors)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Benches; G

Shelters; G

Assembly Instruction Drawings

SD-03 Product Data

Benches

Shelters

Flagpole

Recycled Content for steel components; S

Recycled Content for aluminum components; S

Waste Receptacles

SD-04 Samples

Finish; G

SD-06 Test Reports

Testing

SD-07 Certificates

Primer Certificate

Powder Coatings Certificate

1.3 QUALITY ASSURANCE

Qualify welders in accordance with AWS D1.1/D1.1M using procedures, materials, and equipment of the type required for the work.

1.3.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

1.3.2 Installation Drawings

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation.

1.3.3 Assembly Instruction Drawings

Submit assembly instruction drawings showing layout(s), connections, bolting and anchoring details in accordance with manufacturer's standards. Submit drawings showing scaled details of proposed site furnishings, elevations for each type of site furnishing; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction.

1.3.4 Primer Certificate

Submit a certificate from the manufacturer stating that the primer conforms to requirements of SSPC Paint 25.

1.3.5 Powder Coatings Certificate

Submit a certificate from the manufacturer stating that the powder coat conforms to ASTM D3451.

1.4 DELIVERY, STORAGE, AND HANDLING

Ship items knocked-down (KD) ready for site assembly. Packaged components must be complete including all accessories and hardware. Materials must be delivered, handled, and stored in accordance with the manufacturer's recommendations. Site furnishings must be inspected upon arrival at the job site for conformity to specifications and quality in accordance with paragraph MATERIALS. Protect from corrosion, staining, and other types of damage. Store items in designated area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials which are the standard products of a manufacturer

regularly engaged in the manufacture of such products. The materials provided shall be of a type with proven satisfactory usage for at least 2 years.

2.1.1.1 Metals

Metallic materials and products must conform to Section 08 31 00 ACCESS DOORS AND PANELS. Furnish metal components with factory drilled holes and free of excess weld and spatter. Metal components with holes that will not be filled by hardware or hidden by other components will be rejected. Structural steel products must conform to ASTM A36/A36M, ASTM A500/A500M and ASTM A501/A501M. Provide Steel Components with a minimum of 70 percent recycled content. Provide data identifying percentage of Recycled Content for steel components.

2.1.1.2 Structural Tubing

ASTM A500/A500M

2.1.1.3 Aluminum Products

Provide Aluminum Components with a minimum of 50 percent total recycled content. Provide data identifying percentage of Recycled Content for aluminum components.

2.1.1.4 Cast Aluminum

Cast aluminum must conform to ASTM B26/B26M and ASTM B108/B108M. Provide castings manufactured true to pattern and component parts that fit together in a satisfactory manner. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. Smooth castings must be well-cleaned by sand or shot blasting.

2.1.1.5 Aluminum Alloy Products

Conform to ASTM B209 for sheet plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.1.1.6 Anchors and Hardware

Provide anchors, where necessary, for fastening site furnishings securely in place and in accordance with approved manufacturer's instructions. Anchoring devices that may be used, when no anchors are otherwise specified or indicated, include anchor bolts, slotted inserts, expansion shields for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; and lag bolts and screws for wood. Anchor bolts must conform to ASTM A307. Hardware must be stainless steel in accordance with ASTM A153/A153M and compatible with the material to which applied. All exposed hardware must match in color and finish. Mounting hardware must be concealed, recessed, and plugged.

2.1.6.1 Threaded Inserts and Expansion Anchors

Provide inserts recessed not less than 2.5 inches into concrete or masonry. Pullout 198 pounds in concrete with f'c of 3,000 psi, as tested in accordance with ASTM E488/E488M. Expansion shields must conform to CID A-A-1925, group II, type 4, class 1. Provide embedment required by

manufacturer.

2.1.6.2 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

2.1.6.3 Toggle Bolts

ASME B18.2.1.

2.1.6.4 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A307.

2.1.6.5 Power Driven Fasteners

Follow safety provisions of ASSP A10.3.

2.1.6.6 Screws

ASME B18.2.1, ASME B18.6.2, and ASME B18.6.3.

2.1.6.7 Washers

Provide plain washers to conform to ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

2.1.7 Concrete

Ready-mixed concrete must conform to ASTM C94/C94M, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Portland cement must conform to ASTM C150/C150M. Cast-in-place concrete materials and products must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE. Precast concrete material and products must conform to Section 03 45 33 PRECAST STRUCTURAL CONCRETE. Reinforcing steel must conform to ASTM A615/A615M. Welded wire fabric must conform to ASTM A1064/A1064M.

2.1.8 Masonry

Masonry material and products must conform to Section 04 20 00 UNIT MASONRY

2.2 PRETREATMENT, PRIMING AND PAINTING

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions.

2.2.1 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.2 Aluminum Surfaces

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.3 COATINGS AND FINISHES

2.3.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing must conform to ASTM A123/A123M, ASTM A153/A153M or ASTM A653/A653M, as applicable. Tailings and sharp protrusions formed as a result of the hot-dip process must be removed and exposed edges burnished. Galvanize anchor bolts, grating fasteners, washers and parts or devices necessary for proper installation, unless otherwise indicated.

2.3.2 Polyester Powder

Powder-coated surfaces must receive electrostatic zinc coating prior to painting. Powder coating must be electrostatically applied and oven cured. Polyester powder coating must be resistant to ultraviolet (UV) light.

2.3.3 Polyvinyl-Chloride (PVC)

PVC coating must be primed with a clear acrylic thermosetting solution. The primed parts must be preheated prior to dipping. The liquid polyvinyl chloride must be ultraviolet (UV) stabilized and mold-resistant. The coated parts must be cured. The coating must be a minimum 2/25 inches thick plus or minus 0.020 inches and must have an 85 durometer hardness with a slip-resistant finish.

2.3.4 Finish

Finish must be as specified by the manufacturer or as indicated. Exposed surfaces and edges must be rounded, polished, or sanded. Finish must be non-toxic, non-glare, and resistant to corrosion. Exposed surfaces must be smooth and splinter-free exposed surfaces. Submit two sets of color data for each furnishing displaying manufacturer's color selections and finishes, and identifying those colors and finishes proposed for use.

2.3.4.1 Paint

Paint must be factory applied with a minimum of 2 coats. Paint must be weather-resistant and resistant to cracking, peeling and fading.

2.3.4.2 Color

Color of site furnishing components must be in accordance with manufacturer.

2.4 SITE STANDARDS

Site furnishings must be furnished with the dimensions and requirements indicated. Site furnishings placed in children's outdoor play areas must meet the safety requirements of ASTM F1487 for entrapment; sharp points, edges, and protrusions; entanglement; pinch, crush, and shear points. Site furnishings to be included in children's outdoor play areas must be free from sharp vertical edges and any protruding elements and designed with a minimum radius of 1/2 inch on all vertical edges; this includes, but is not limited to, seat walls, containment curbs and planters. Where practical, horizontal edges exposed to children's activities must be rounded.

2.5 Benches

Furnish benches with no sharp edges or protruding hardware.

- a. Height: The height above finished grade or specified surface must be between 18-20 inches and level.
- b. Seat: The seat surface must be pitched or slotted to shed water; the seat depth must be between 12-18 inches and pitched down at the back at a 0-5 degree angle. Seat must have a minimum width of 24 inches per person, and must overhang the support base by a minimum of 4 inches for heel space and to facilitate rising from a seating position.
- c. Back Rest: When back rests are required, the height must be between 15-18 inches from the top of the seat and the connection must be at a 90-110 degree angle to the seat.
- d. Arm Rest: When arm rests are required, a minimum of 6 inches height from the seat and a minimum arm rest width of 1-1/2 inches must be provided.
- e. Weight Limit: Seats must support a minimum 300 lbs for each person they are designed to accommodate.

2.6 WASTE RECEPTACLES

Provide for waste receptacles hot dipped galvanized and powder coat finish domed tops, rain bonnet lid and removable semi-rigid plastic liner insert. Waste receptacles must be furnished with weather protection, odor containment, and insect/animal-proofing. Container size must be 36 gallon.

2.6.1 Height

Trash and litter deposit openings must be between 30-40 inches above the ground.

2.6.2 Liners

Trash and litter receptacles must be furnished with removable/reusable inner containers. Self-dumping type designs to include hinged bottom, top or sides will be rejected.

2.6.3 Anchors

Trash and litter receptacles that can be anchored to resist overturning by typical use, high winds, or animals must be furnished and anchored in accordance with the manufacturer's recommendations.

2.6.4 Openings

Openings for trash and litter insertion must be a minimum of 4 inches in diameter. Edges of the openings must be crimped, rounded and smoothed.

2.6.5 Metal Waste Receptacle

Provide metal waste receptacles as indicated, fabricated from steel frame with steel staves welded to frame; powder coat finish, color as selected.

- a. Metal thickness, width, and configuration must be manufacturer's standard. Chemically clean and phosphate coat prior to final powdercoat.
- b. Provide 36 gallon capacity high density plastic liner.

2.7 Flagpole

Provide for flagpole tapered aluminum alloy, top ball, yardarms, aluminum cleats, halyards, truck and aluminum flash collar.

2.7.1 Height

Flagpole exposed height shall be 30'.

2.7.2 Top Ball

Top Ball shall be 14 gauge spun aluminum gold anodized.

2.7.3 Yardarms, Cleats Haylards, Truck and Flash Collar

Yardarms shall 6 inch diameter aluminum alloy, 8 feet in length. Cleats shall be 9 inches in height cast aluminum. Provide three cleats. Halyard sets shall be #10 poly with bronze swivel snaps and covers per halyard. Provide three sets of halyards. Truck shall be cast aluminum revolving non-fouling single sheave truck. Aluminum flash collar.

2.7.4 Foundation

Foundation design must conform to all applicable State and Local Building Codes and must meet manufacturer's standards of construction and materials.

2.7.5 Lightning System

Flagpole lighting shall be downward facing solar-powered with a rechargeable lithium battery. Fixture shall be Waterproof/weatherproof LED with a color temperature of 4000K, and a minimum lumen package of 800LM. Provide integrated automatic switch for on/off at dusk/dawn.

2.8 SHELTERS

AISC 360. Provide prefabricated shelter systems to meet design conditions indicated. Shelter design must conform to all applicable State and Local Building Codes and must meet manufacturer's standards of construction and materials. Shelter systems must be pre-drilled and pre-cut, shipped with all hardware and accessories necessary for complete field assembly.

2.8.1 Framing Systems

Framing system; columns, rafters, ridge, purlins and other structural framing members must be steel as indicated. Manufacturer must provide shop drawings and calculations prepared by a structural engineer.

2.8.1.1 Steel

Structural steel must conform to ASTM A36/A36M or ASTM A500/A500M, 36,000 psi yield strength and 58,000 psi tensile strength, factory finished with rust inhibited primer and powder coat conforming to ASTM D3451. Framing sizes and configurations must be as required for size of structure

indicated meeting manufacturer's standard and applicable building codes.

2.8.2 Roof Panels

Provide manufacturer's standard standing seam metal roof panels as indicated. Materials must be factory finished and shipped with all necessary fasteners and accessories as required for complete site assembly.

PART 3 EXECUTION

3.1 INSTALLATION

Verify that finished grades and other operations affecting mounting surfaces have been completed prior to the installation of site furnishings. Site furnishings must be installed plumb and true, at locations indicated, in accordance with the approved manufacturer's instructions.

3.1.1 Assembly and Erection of Components

New parts must be acquired from the manufacturer; substitute parts will not be accepted unless approved by the manufacturer. When the inspection of parts has been completed, the site furnishings must be assembled and anchored according to manufacturer's instructions or as indicated. When site furnishings are assembled at the site, assembly must not interfere with other operations or pedestrian and vehicular circulation.

3.1.2 Anchorage, Fastenings, and Connections

Furnish metal work, mounting bolts or hardware in ample time for securing into concrete or masonry as the work progresses. Provide anchorage where necessary for fastening furniture or furnishings securely in place. Provide, for anchorage not otherwise specified or indicated, slotted inserts, expansion shields, and power-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish the fastenings to which they are applied. Conceal fastenings where practicable.

3.2 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.3 TESTING

Test each site furnishing to ascertain a secure and correct installation. A correct installation must be according to the manufacturer's recommendations and by the following procedure: Measure the physical dimensions and clearance of each installed site furnishing for compliance with manufacturer's recommendations and as indicated. Site furnishings which do not comply must be reinstalled. Fasteners and anchors determined to be non-compliant must be replaced. Submit a written report describing the results of the testing and a report of post-installation test results.

3.4 FINISHES

3.4.1 Field Finishes

Where indicated, field finishes must be applied in accordance with Section 09 90 00 PAINTS AND COATINGS. Where dissimilar metals are in contact, protect surfaces with a coat conforming to SSPC Paint 25 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D1187/D1187M, asphalt-base emulsion.

3.4.2 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved by the Contracting Officer. Clean areas to be repaired and remove the slag from the welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread the molten material uniformly over surfaces to be coated and wipe the excess material off.

3.5 SHELTERS

Secure to the adjacent construction with the clip angles attached to the concrete. Secure to concrete with not less than two 1/2 inch diameter expansion bolts.

3.5.1 Roof

Provide manufacturer's standard roof system including fascia assembly, ensuring a weather-tight seal and installation.

3.6 RESTORATION AND CLEAN UP

When the installation has been completed, clean up and protect the site. Existing areas that have been damaged from the installation operation must be restored to original condition at Contractor's expense.

3.6.1 Clean Up

The site must be cleaned of all materials associated with the installation. Site furnishing surfaces must be cleaned of dirt, stains, filings, and other blemishes occurring from shipment and installation. Cleaning methods and agents must be according to manufacturer's instructions or as indicated.

3.6.2 Protection

The area must be protected as required or directed by providing barricades and signage. Signage must be in accordance with Section 10 14 00.10 EXTERIOR SIGNAGE.

3.6.3 Disposal of Materials

Excess and waste material must be removed and disposed off Government property.

3.7 RE-INSTALLATION

Where re-installation is required, the following must be accomplished:

- a. Re-install the product as specified. Material acquisition of replacement parts is the responsibility of the Contractor. Provide replacement materials that are new and supplied by the original manufacturer to match.
- b. Damage caused by the failed installation must be repaired.

-- End of Section --

SECTION 13 21 26

COLD-STORAGE ROOMS (PREFABRICATED PANEL TYPE)

02/16, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 420 (2008) Performance Rating of
Forced-Circulation Free-Delivery Unit
Coolers for Refrigeration

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ANSI/ASHRAE 15 & 34 (2013) ANSI/ASHRAE Standard 15-Safety
Standard for Refrigeration Systems and
ANSI/ASHRAE Standard 34-Designation and
Safety Classification of Refrigerants

ASHRAE 189.1 (2014) Standard for the Design of
High-Performance Green Buildings Except
Low-Rise Residential Buildings

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

NSF INTERNATIONAL (NSF)

NSF/ANSI 7 (2019) Commercial Refrigerators and
Freezers

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-R-43900 (1985; Rev B; Notice 1; CANC Notice 2)
Refrigerators, Freezers, Prefabricated,
Mechanical, Commercial, Walk-In

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star (1992; R 2006) Energy Star Energy
Efficiency Labeling System (FEMP)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-52128 (Basic) Shelving, Storage, Stationary and
Mobile, Food Storage

UNDERWRITERS LABORATORIES (UL)

UL 412 (2011; Reprint Sep 2013) Standard for
Refrigeration Unit Coolers

UL 427 (2011; Reprint Feb 2014) Refrigerating
Units

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Cold-Storage Rooms; G

SD-03 Product Data

Cold-Storage Rooms; G

Shelves; G

Refrigeration Equipment; G

Energy Star Label For Refrigeration Equipment; S

SD-06 Test Reports

Start-Up and Initial Operational Tests; G

Flame Spread and Smoke Index; G

SD-08 Manufacturer's Instructions

Cold-Storage Rooms

Refrigeration Equipment

SD-10 Operation and Maintenance Data

Cold-Storage Rooms, Data Package 1; G

Refrigeration Equipment, Data Package 2; G

SD-11 Closeout Submittals

Posted Operating Instructions for Refrigeration Equipment; G

PART 2 PRODUCTS

2.1 COLD-STORAGE ROOMS

2.1.1 Requirements

MIL-R-43900, factory fabricated type with the following requirements:

- a. Type : prefabricated walk-in freezer
- b. Size : as indicated on drawings
- c. Entrance doors must be swing type with left-handed openings and self closing door. Hardware to include heavy duty adjustable cam-lift hinges, deadbolt locking handle with independent key/padlock feature and inside safety release, full perimeter gasketing.
- d. Refrigeration systems must be the self-contained type mounted to roof of cold-storage room.
- e. Electrical characteristics.
- f. Preservation and packing must be commercial grade.
- g. Recording thermometer.
- h. Temperature alarm system.
- i. Interior lighting - high output/low profile LED positioned to prevent interference with shelving.
- j. Condensing unit outdoor controls for operation down to 0 F ambient temperature.
- k. Freezer enclosure to be constructed of modular interlocking metal clad insulated panels. Cladding to be 26G corrosion resistant stucco embossed coated steel. Cladding color to be selected from manuf standard colors.
- l. Foam plastic insulation flame spread and smoke index limits in accordance with requirements in ICC IBC Chapter 26 Plastic.
- m. Unit floor to be slip resistant.
- n. Warranties to include; 15 year panel warranty and 5 year compressor warranty.
- o. Provide manufacturer metal trim panels between face of enclosure and adjacent walls.

2.2 SHELVES

CID A-A-52128, stationary type, slotted shelves, stainless steel construction, u-shaped shelving system with four tiers, size designed to maximize shelving within unit, min 24 inch depth.

2.3 REFRIGERATION EQUIPMENT

MIL-R-43900, except as modified in this section. Design refrigerant equipment for self-contained installation. Design units for 16 to 18 hour operation at the indicated interior temperature in -10 F ambient temperature. Provide equipment with capacities, air delivery, and dimensions indicated. Provide refrigeration equipment that is Energy Star labeled. Provide data identifying Energy Star label for refrigeration equipment.

2.3.1 Evaporators

Factory fabricated and rated in accordance with UL 412 and AHRI 420. Provide forced convection, unit cooler type, made to be suspended from the ceiling panels, with forced air discharged parallel to the ceiling. Provide with air circulating motor, multfin tube-type coil and grille assembled within a protective housing. Air circulation motors must be lifetime sealed. The entire unit cooler assembly must be accessible for cleaning. Provide a drip pan and drain connection. When the cold storage room is used for freezing, provide an automatic electric heat defrosting system. Provide demand type defrost controllers.

2.3.2 Self-Contained Refrigerant Systems

Factory fabricated in accordance with UL 427 for top-wall/roof mounting. Systems to include a condensing unit mounted on the exterior and a forced air evaporator mounted on the interior directly opposite.

Provide in accordance with ANSI/ASHRAE 15 & 34 and ASHRAE 189.1. Provide condensing unit assembly with all necessary components factory installed and wired including electrical box, time clock, drier, sight glass, enclosed compressor housing, and compressor rack. Set chiller to operate at -10 degrees F. Mercury is prohibited for use in thermometers. Chlorofluorocarbon (CFC) based refrigerants are prohibited.

2.4 ELECTRICAL

The unit's main power connection shall be a 208V, 1-phase connection, 30A OCPD. Provide a separate 120V connection for lights and miscellaneous controls.

PART 3 EXECUTION

3.1 INSTALLATION

Provide in accordance with NSF/ANSI 7, ANSI/ASHRAE 15 & 34, ASHRAE 189.1, and with the manufacturer's printed instructions. Submit installation instructions covering both assembly of the rooms and installation of the refrigeration equipment, for approval by the Contracting Officer's Representative prior to starting installation. Include equipment start-up and initial operation as well as evacuation and charging procedures for refrigeration equipment in the installation instructions.

3.2 MANUFACTURER'S FIELD SERVICES

3.2.1 Services

Provide manufacturer's representatives who are trained to perform the services specified. Representatives to provide training services on the following procedures:

- a. Erection, alignment, and testing.
- b. Charging equipment with refrigerant and oil.
- c. Starting equipment and training government personnel in proper care, operation, and maintenance.

3.3 TESTS

Perform the tests for each room and provide everything required. Notify the Contracting Officer 10 days before performing the tests. Perform tests in the presence of a manufacturer's representative.

3.3.1 Start-Up and Operational Tests

Upon completion of equipment and refrigerant piping installation, start-up and operate systems for a period of not less than 24 hours. Place safety and automatic controls in operation and sequence. Record manufacturer's recommended readings hourly.

3.3.2 Performance Tests

Upon completion of operational tests, performance test systems for not less than 8 hours. Include the following information in the test report with conclusions regarding the adequacy of systems:

- a. Time, dates and duration of tests.
- b. Inside dry-bulb and wet-bulb temperatures maintained in each room during tests employing recording instruments calibrated before the tests.
- c. Outside dry-bulb and wet-bulb temperatures obtained from recording instruments calibrated and checked hourly with a sling psychrometer.
- d. Evaporator and condenser entering and leaving temperatures taken hourly with compressors in operation.
- e. Make, model and capacity of each evaporator and condensing unit.
- f. Voltmeter and ammeter readings for condensing units and evaporators.

3.4 OPERATING INSTRUCTIONS

Provide a framed and glassed control chart indicating layout of refrigeration systems, including piping, valves, wiring, and control mechanisms. Install control chart where directed. Submit printed instructions covering the maintenance and operation of refrigeration equipment. Tag shutoff valves in accordance with printed instructions. Provide special tools necessary for repair and maintenance of the equipment. Submit data package 2 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

3.5 CLEANING

Remove masking protection from stainless steel and other finished surfaces. Wash and clean floors, walls, shelves, and ceilings inside rooms and on exposed exterior surfaces. Clean glass, fixtures and fittings.

3.6 INSTRUCTING OPERATING PERSONNEL

Upon completion of the work and at a time designated by the Contracting Officer, provide instruction to Government personnel in the operation and maintenance of each refrigeration system. Duration of instruction must be a minimum of one 8-hour working day.

-- End of Section --

SECTION 13 22 00

HAZMAT CONTAINERS

11/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 704 (2017) Standard System for the
Identification of the Hazards of Materials
for Emergency Response

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M (2020) Standard Specification for Steel
Sheet, Zinc-Coated (Galvanized) or
Zinc-Iron Alloy-Coated (Galvannealed) by
the Hot-Dip Process

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 3 (2013) Molded Case Circuit Breakers and
Their Application

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Hazmat Container; G

SD-03 Product Data

Hazmat Container; G

SD-08 Manufacturer's Instructions

Hazmat Container, Data Package 1; G

SD-10 Operation and Maintenance Data

Hazmat Container; G

1.3 OPERATION AND MAINTENANCE SUBMITTALS

Submit Operation and Maintenance Manuals for Hazmat Container.

PART 2 PRODUCTS

2.1 GENERAL CHARACTERISTICS OF HAZMAT CONTAINER

Contractor to provide one (1), pre-engineered, free standing, relocatable hazardous material storage building. Container to be 42 feet long x 8 feet wide x 8 feet-4 inches tall. Container to be Factory Mutual System (FM) approved and labeled. Warranty to include 15 year structural.

2.2 MATERIALS AND CONSTRUCTION

All containers for the storage of flammable or combustible liquids and other hazardous materials shall include the following components.

2.2.1 Building Base

Open channel construction for forklift and/or crane slings and under building inspections.

4 hold-down brackets (structural steel angles) for building to concrete slab for seismic and wind load anchoring as required per drawings.

2.2.2 Exterior/Sump Wall and Roof/Ceiling Construction

Weatherproof noncombustible construction.. Exterior and interior wall/ceiling faces to be A60 galvanized steel (ASTM A653/A653M). Roof/ceiling permanently attached to exterior walls. Roof to be sloped away from door opening to facilitate rainwater runoff. Construction to be designed resist an internal pressure of 100 PSF.

Sump to provide a minimum 30% of container storage capacity.

2.2.3 Door

Provide 1 door, 60 inches wide x 80 inches high. Hardware to include UL classified and labeled commercial grade keyed lockset with keyless interior safety release lever and door closer for active leaf.

2.2.4 Floor

Provide galvanized steel floor planking, designed to hold 250 PSF. Planking to be removable to facilitate sump cleaning in the event of a spill.

2.3 FINISHES

Interior; High solids, chemical-resistant epoxy coating with a white aliphatic polyurethane topcoat.

Exterior; High solids, chemical-resistant epoxy undercoat with heat reflective white aliphatic polyurethane topcoat.

2.4 STATIC GROUNDING SYSTEM

1 exterior grounding connection, 1 - 10 feet long 5/8 inch diameter copper

grounding rod, 1 #4AWG copper conductor and grounding lugs

2.5 SIGNAGE

D.O.T. hazard classification placard, rust-roof aluminum holder and stainless steel clips and pressure sensitive NFPA 704 Hazard Rating Sign.

2.6 INTERIOR LIGHTING

UL-listed explosion-proof LED light fixture with a 40 watt maximum, 20 watt minimum lamp (120V, 1.25A, 1-Phase) rated for Class 1, Div 1, Groups C & D.

Heavy-duty glass globe with a sealed, heavy-duty aluminum housing and equipped with a protective metal guard.

Exterior UL listed non explosion-proof light switch (snap type) suitable for outdoor locations.

2.7 LOAD CENTER

UL listed, 208/120V, single-phase load center NEMA AB 3(NEMA 4X stainless steel) with circuit breaker and 30A main breaker.

2.8 EXHAUST VENTILATION

UL Listed totally enclosed (Class I, Division 1 Groups C&D) motor (60 Hz, 1-Phase) housed inside an exterior end wall enclosure. Non-static & non-sparking 12 inch diameter fan blade to preclude the ignition of hazardous vapors. Exterior exhaust fan housing constructed of heavy gauge steel, with an exterior polyurethane finish for maximum chemical & corrosion resistance. Interior exhaust vent located within 12 inches of the floor for the extraction of heavier-than-air vapors. Exterior exhaust fan port opening protected with a UL Classified fire damper having a 3-hour fire protection rating. Fire damper has a galvanized steel frame, curtain-type galvanized steel blades, and a UL Listed 165 degrees F fusible link. Exterior exhaust port equipped with shutter assembly. Equipped with an exterior UL Listed Non Explosion-Proof fan switch (break glass continuous run) suitable for outdoor locations. Automatic system shutdown if fire occurs.

2.9 PRESSURE DIFFERENTIAL SWITCH SYSTEM

UL Listed and CSA approved (Class I, Division 1 Groups C&D) Pressure Switch activated in case of continuous ventilation shut-down. Equipped with one (1) exterior UL Listed Non Explosion-Proof, Weatherproof audible alarm (120V, 0.16A, 1-Phase). System equipped with a means for remote annunciation.

2.10 EMERGENCY LOCAL ALARM SYSTEM

Exterior UL Listed Non Explosion-Proof Emergency Local Alarm Switch with UL Listed Non Explosion-Proof, Weatherproof Audible Alarm (120V, 0.16A, 1-Phase). System equipped with a means for remote annunciation.

PART 3 EXECUTION

3.1 Start-Up

Provide start-up and initial operational tests before turn over to contracting officer.

-- End of Section --

SECTION 13 34 19

METAL BUILDING SYSTEMS

08/20, CHG 1: 02/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 621-02	(2002) Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates
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AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2017) Steel Construction Manual
AISC 341	(2016) Seismic Provisions for Structural Steel Buildings
AISC 360	(2016) Specification for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121	(2007) Standard Definitions for Use in the Design of Steel Structures
AISI D100	(2017) Cold-Formed Steel Design Manual

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures
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AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings
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AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

AWS D1.3/D1.3M (2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153/A153M (2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A193/A193M (2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications

ASTM A307 (2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

ASTM A463/A463M (2015; R 2020; E 2020) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

ASTM A500/A500M (2021a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A501/A501M (2014) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

ASTM A529/A529M (2019) Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality

ASTM A563 (2015) Standard Specification for Carbon and Alloy Steel Nuts

ASTM A563M (2007; R 2013) Standard Specification for Carbon and Alloy Steel Nuts (Metric)

ASTM A572/A572M (2021; E 2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

ASTM A606/A606M (2018) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved

Atmospheric Corrosion Resistance

ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A755/A755M	(2018) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A792/A792M	(2010; R 2015) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A992/A992M	(2020) Standard Specification for Structural Steel Shapes
ASTM A1008/A1008M	(2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1011/A1011M	(2018a) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B695	(2004; R 2016) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C273/C273M	(2020) Standard Test Method for Shear Properties of Sandwich Core Materials
ASTM C518	(2017) Standard Test Method for Steady-State Thermal Transmission

Properties by Means of the Heat Flow Meter
Apparatus

ASTM C665	(2017) Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C1289	(2020) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C1363	(2019) Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM D522/D522M	(2017) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D714	(2002; R 2017) Standard Test Method for Evaluating Degree of Blistering of Paints
ASTM D822	(2013; R 2018) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	(2017) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1308	(2002; R 2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1621	(2016) Standard Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM D1622/D1622M	(2014) Apparent Density of Rigid Cellular Plastics
ASTM D1667	(2017) Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2244	(2016) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color

Coordinates

ASTM D2247	(2015) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	(1993; R 2019) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D5359	(2015) Standard Specification for Glass Cullet Recovered from Waste for Use in Manufacture of Glass Fiber
ASTM D6226	(2015) Standard Test Method for Open Cell Content of Rigid Cellular Plastics
ASTM DEFONLINE	(2008) ASTM Online Dictionary of Engineering Science and Technology
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E119	(2020) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E136	(2019a) Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C
ASTM E283	(2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2016) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E1592	(2017) Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E1646	(1995; R 2018) Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Air Pressure Difference

ASTM E1680	(2016) Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems
ASTM F436/F436M	(2019) Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
ASTM F844	(2019) Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1852	(2014) Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
ASTM G152	(2013) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2013) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM	(2018) Metal Building Systems Manual
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NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(2019) Standard for Fire Doors and Other Opening Protectives
NFPA 252	(2017) Standard Methods of Fire Tests of Door Assemblies

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan	(2020) The NRCA Roofing Manual
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SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA 1793 (2012) Architectural Sheet Metal Manual,
7th Edition

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 15 (1999; E 2004) Steel Joist Shop
Primer/Metal Building Primer

SSPC Painting Manual (2002) Good Painting Practice, Steel
Structures Painting Manual, Volume 1

SSPC SP 2 (2018) Hand Tool Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety -- Safety and Health
Requirements Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2019) Structural Engineering

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (updated continuously online) Building
Materials Directory

1.2 GENERAL REQUIREMENTS

1.2.1 Design Parameters

Design and construct pre-engineered metal buildings of size, shape, height, fenestration, siting, and configuration indicated. Coordinate site utility services, accessibility requirements, vehicular and pedestrian access, mechanical, electrical, plumbing and fire protection requirements, interior construction and finishes, and such other items as may be necessary for a complete, functional building.

1.2.2 Structural Performance

Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within the limits and conditions indicated.

1.2.2.1 Engineering

Design metal building systems conforming to procedures described in MBMA MBSM.

1.2.2.2 Design Loads

Design and construct to the requirements of UFC 3-301-01, Structural Engineering.

1.2.3 Thermal Performance

Provide insulated metal panel assemblies with the following maximum U-factors when assemblies are tested or calculated according to ASHRAE 90.1 - IP Appendix A, and minimum R-values for opaque elements when tested according to ASTM C1363 or ASTM C518. Refer to drawings for required R and/or U-values.

1.2.4 Air Infiltration for Metal Roof Panels

Air leakage through assembly must not exceed 0.04 cfm/sq.ft. of roof area when lab tested according to ASTM E1680 at negative test-pressure difference of 1.57 lbf/sq.ft.

1.2.5 Air Infiltration for Metal Wall Panels

Air leakage through assembly of not more than 0.04 cfm/sq.ft. of wall area when labtested according to ASTM E283 at static-air-pressure difference of 1.57 lbf/sq.ft.

1.2.6 Water Penetration for Metal Roof Panels

No water penetration when tested according to ASTM E1646 at test-pressure difference of 2.86 lbf/sq.ft.

1.2.7 Water Penetration for Metal Wall Panels

No water penetration when tested according to ASTM E331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq.ft. and not more than 12 lbf/sq. ft.

1.2.8 Specular Gloss

Finished roof surfaces to have a specular gloss value of 30 plus or minus 5 at an angle of 60 degrees when measured in accordance with ASTM D523.

1.2.9 Wind-Uplift Resistance

Design for wind-uplift resistance in accordance with UFC 3-301-01.

1.2.10 Erection Plan

Provide plans and a written erection/lifting procedure with required plans clearly showing the intended sequence and method of erection in accordance with EM 385-1-1 "Safety - Safety and Health Requirements". Indicate required crane lifting requirements, temporary support structures, member size and locations of braced or guyed temporary supports, and locations of bracing or guys anchor points. Clearly define the required framing sequence and conditions necessary to ensure the structure is maintained in a properly braced and stable condition throughout the complete erection process.

1.3 DEFINITIONS

- a. Bay: Dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured normal to end wall (outside face of end-wall girt) for end bays.

- b. Clear Span: Distance between supports of beams, girders, or trusses (measured from lowest level of connecting area of a column and a rafter frame or knee).
- c. Eave Height: Vertical dimension from finished floor to eave (the line along the sidewall formed by intersection of the planes of the roof and wall).
- d. Terminology Standard: Refer to MBMA "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

1.4 SYSTEM DESCRIPTION

General: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, metal roof panels, metal wall panels, and accessories complying with requirements indicated.

Provide metal building system of size and with spacing, slopes, and spans indicated.

1.4.1 Primary Frame Type

- a. Rigid Clear Span: Solid-member, structural-framing system without interior columns.

1.4.2 Fixed End-Wall Framing

Provide manufacturer's standard fixed end wall, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.

1.4.3 Secondary Frame Type

Provide manufacturer's standard purlins and joists and exterior-framed (bypass) girts.

1.4.4 Eave Height

As indicated on drawings.

1.4.5 Bay Spacing

As indicated on drawings.

1.4.6 Roof Slope

As indicated on drawings.

1.4.7 Roof System

Provide manufacturer's standard vertical-rib, standing-seam metal roof panels with insulation.

1.4.8 Exterior Wall System

Provide factory-assembled, insulated metal wall panels.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Qualifications; G

SD-02 Shop Drawings

Detail Drawings; G

Erection Plan

SD-03 Product Data

Manufacturer's Catalog Data; G

Recycled Content for Structural Steel Shapes and Plates; S

Recycled Content for Steel Pipe; S

Recycled Content for Steel Sheet Materials; S

Recycled Content for Insulation Materials; S

SD-04 Samples

Roof Panels; G

Wall Panels; G

Color Chips, 4 by 4 inches

SD-05 Design Data

Manufacturer's Descriptive and Technical Literature; G

Manufacturer's Building Design Analysis; G

Lateral Force Calculations; G

SD-06 Test Reports

Test Reports

Coatings and Base Metals

Factory Color Finish Performance Requirements

SD-07 Certificates

System Components; G

Coil Stock Certificates; G

Aluminized Steel Repair Paint; G

Galvanizing Repair Paint; G

Enamel Repair Paint; G

Qualification of Manufacturer

Qualification of Erector

SD-08 Manufacturer's Instructions

Installation of Roof and Wall panels

Shipping, Handling, and Storage

SD-11 Closeout Submittals

Manufacturer's Warranty

Contractor's Warranty for Installation

1.6 QUALITY ASSURANCE

1.6.1 Pre-Erection Conference

After submittals are received and approved but before metal building system work, including associated work, is performed, the Contracting Officer will hold a pre-erection conference to review the following:

- a. The detail drawings, specifications, and manufacturer's descriptive and technical literature.
- b. Finalize construction schedule and verify availability of materials, erector's personnel, equipment, and facilities needed to make progress and avoid delays.
- c. Methods and procedures related to metal building system erection, including, but not limited to: qualification of manufacturer, qualification of erector, manufacturer's catalog data, manufacturer's building design analysis, lateral force calculations, written instructions and test reports. Lateral force calculations must include all analysis and confirmation of system components required to transfer lateral forces to the foundation.
- d. Support conditions for compliance with requirements, including alignment between and erection of structural members.
- e. Flashing, special roofing and siding details, roof and wall penetrations, openings, and condition of other construction that will affect the metal building system, including coatings and base metals, factory color finish performance requirements, system components, and coil stock certificates.
- f. Governing regulations and requirements for, certificates, insurance,

tests and inspections if applicable.

- g. Temporary protection requirements for metal panel assembly during and after installation.
- h. Samples of roof panels, wall panels, aluminized steel repair paint, galvanizing repair paint, and enamel repair paint.

1.6.1.1 Pre-Roofing and Siding Installation Conference

After structural framing system erection and approval but before roofing, siding, insulation and vapor barrier work, including associated work, is performed; the Contracting Officer will hold a pre-roofing and siding conference to review the following:

- a. Examine purlins, sub-girts and formed shapes conditions for compliance with requirements, including flatness and attachment to structural members.
- b. Review structural limitations of purlins, sub-girts and formed shapes during construction and after roofing and siding.
- c. Review flashings, special roof and wall details, roof drainage, roof and wall penetrations, roof equipment curbs, and condition of other construction that will affect the metal building system.
- d. Review temporary protection requirements for metal roof and wall panels' assembly during and after installation.
- e. Review roof and wall observation and repair procedures after metal building system erection.

1.6.2 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products, erection of structural framing and installation of roof and wall panels in the geographical area where construction will take place.

1.6.3 Manufacturer's Qualifications

Metal building system manufacturer must have a minimum of five years experience as a qualified manufacturer and a member of MBMA of metal building systems and accessory products.

Provide engineering services by an authorized currently licensed engineer in the geographical area where construction will take place, having a minimum of four years experience as an engineer knowledgeable in building design analysis, protocols and procedures for the "Metal Building Systems Manual" (MBMA MBSM); ASCE 7-16, the building code in the geographic area where the construction will take place and ASTM E1592. Provide certified engineering calculations using the products submitted for:

- a. Roof and Wall Wind Loads with basic wind speed, exposure category, co-efficient, importance factor, designate type of facility, negative pressures for each zone, methods and requirements of attachment.
- b. Roof Dead and Live Loads

- c. Collateral Loads
- d. Foundation Loads
- e. Roof Snow Load
- f. Seismic Loads

1.6.4 Qualification of Erection Contractor

An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and must be approved and certified by the metal building system manufacturer.

1.6.5 Single Source

Obtain primary and secondary components and structural framing members, each type of metal roof, wall and liner panel assemblies, clips, closures and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.6.6 Welding

Qualify procedures and personnel according to AWS A5.1/A5.1M, AWS D1.1/D1.1M, and AWS D1.3/D1.3M.

1.6.7 Structural Steel

Comply with AISC 325, AISC 341 for seismic impacted designs, AISC 360, for design requirements and allowable stresses.

1.6.8 Cold-Formed Steel

Comply with AISC/AISI 121 and AISI D100 for design requirements and allowable stresses.

1.6.9 Fire-Resistance Ratings

Where indicated, provide metal panels identical to those of assemblies tested for fire resistance in accordance with ASTM E119, as certified by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

Indicate design designations from UL Bld Mat Dir or from the listings of another qualified testing agency. Combustion Characteristics must conform to ASTM E136.

1.6.10 Surface-Burning Characteristics

Provide metal panels having insulation core material with the following surface-burning characteristics as determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency showing:

- a. Flame-Spread Index: 25 or less.
- b. Smoke-Developed Index: 450 or less.

1.6.11 Fabrication

Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles with dimensional and structural requirements. Provide metal panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Aluminum and aluminum-alloy sheet and plate must conform to ASTM B209. Fabricate metal panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

- a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- c. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
- d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
- e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA or by metal building system manufacturer for application, but not less than thickness of metal being secured.

1.6.12 Finishes

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.7 SHIPPING, HANDLING AND STORAGE

1.7.1 Delivery

Package and deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed and protected during transportation and handling.

1.7.2 Storage

Stack and store metal panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Store in a manner to prevent

bending, warping, twisting, and surface damage. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage. Retain strippable protective covering on metal panel for entire period up to metal panel installation.

1.7.3 Protection of Materials

Protect foam-plastic insulation as follows:

- a. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
- b. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to project site before installation time.

Complete installation and concealment of plastic materials as rapidly as possible in each area of construction to minimize ultraviolet exposure.

1.8 PROJECT CONDITIONS

1.8.1 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into existing panel system or building.

1.8.2 Field Measurements

1.8.2.1 Established Dimensions for Foundations

Comply with established dimensions on approved anchor-bolt plans, established foundation dimensions, and proceed with fabricating structural framing. Do not proceed without verifying field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.

1.8.2.2 Established Dimensions for Metal Panels

Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.8.2.3 Verification Record

Verify locations of all framing and opening dimensions by field measurements before metal panel fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

Coordinate final design and placement of foundation between structural engineer of record, geotechnical engineer, MBMA and Contractor. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in section on CAST-IN-PLACE CONCRETE.

Coordinate installation of fire suppression system, equipment supports, piping and supports and accessories, which are specified in Division 21 - FIRE SUPPRESSION.

Coordinate installation of plumbing system, equipment supports, piping and supports and accessories, which are specified in Division 22 - PLUMBING.

Coordinate installation of HVAC system, equipment supports, piping and supports and accessories, which are specified in Division 23 - HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).

Coordinate installation of equipment supports and roof penetrations, which are specified in Division 07 - THERMAL AND MOISTURE PROTECTION.

Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.

1.10 WARRANTY

1.10.1 Building System Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal building system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government. The warranty must provide that if within the warranty period, the metal building system shows evidence of deterioration resulting from defective materials or workmanship, correcting of any defects is the responsibility of the metal building system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal building system is under warranty are to be performed within 32 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 32 hours of notification will constitute grounds for having emergency repairs performed by others and will not void the warranty.

1.10.2 Roof System Weather-Tightness Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the roof panel system shows evidence of corrosion, perforation, rupture, loss of weather-tightness or excess weathering due to deterioration of the panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal building system manufacturer.

Repairs that become necessary because of defective materials and workmanship while roof panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform temporary repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty. Immediate follow-up and completion of permanent repairs must be performed within 7 days from date of notification.

1.10.3 Roof and Wall Panel Finish Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the metal panel system shows evidence of checking, delaminating cracking, peeling, chalk in excess of a numerical rating of eight, as determined by ASTM D4214 test procedures; or change colors in excess of five CIE or Hunter units in accordance with ASTM D2244 or excess weathering due to deterioration of the panel system resulting from defective materials and finish or correction of the defective workmanship is to be the responsibility of the metal building system manufacturer.

Liability under this warranty is exclusively limited to replacing the defective coated materials.

Repairs that become necessary because of defective materials and workmanship while roof and wall panel system is under warranty are to be performed within 32 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 32 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

PART 2 PRODUCTS

2.1 STRUCTURAL FRAMING MATERIALS

2.1.1 Steel Shapes and Plates

Wide flange and WT shapes: ASTM A992/A992M; ASTM A572/A572M or ASTM A529/A529M. Angles, Channels and Plates: ASTM A36/A36M, ASTM A572/A572M or ASTM A529/A529M. Provide structural steel shapes and plates containing a minimum of 80 percent recycled content. Submit data identifying percentage of recycled content for structural steel shapes and plates.

2.1.2 Steel Pipe

ASTM A36/A36M, ASTM A53/A53M, ASTM A572/A572M or ASTM A529/A529M. Provide steel pipe containing a minimum of 50 percent recycled content. Submit data identifying percentage of recycled content for steel pipe.

2.1.3 Cold-Formed and Hot Formed Hollow Structural Sections

Cold formed: ASTM A500/A500M or ASTM B221, ASTM B221M. Hot-formed: ASTM A501/A501M.

2.1.4 Structural-Steel Sheet

Hot-rolled, ASTM A1011/A1011M or cold-rolled, ASTM A1008/A1008M.

2.1.5 Metallic-Coated Steel Sheet

ASTM A653/A653M, ASTM A606/A606M.

2.1.1.6 Metallic-Coated Steel Sheet Pre-painted with Coil Stock Coating

Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A755/A755M.

- a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, and ASTM A123/A123M.
- b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, and ASTM A463/A463M.

2.1.1.7 Joist Girders

Refer to Section 05 21 00 STEEL JOIST FRAMING

2.1.1.8 Steel Joists

Refer to the following sections subject to project design requirements:

Section 05 21 00 STEEL JOIST FRAMING

2.1.1.9 High-Strength Bolts, Nuts, and Washers

ASTM F3125/F3125M, heavy hex steel structural bolts; ASTM A563 heavy hex carbon-steel nuts; and ASTM F436/F436M hardened carbon-steel washers.

Finish: Plain Hot-dip zinc coating, ASTM A153/A153M Mechanically deposited zinc coating, ASTM B695.

Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F1852, heavy-hex-head steel structural bolts with spline.

Finish: Plain Mechanically deposited zinc coating, ASTM B695
Mechanically deposited zinc coating, ASTM B695 baked epoxy coated.

2.1.1.10 Non-High-Strength Bolts, Nuts, and Washers

ASTM A307, ASTM A563, and ASTM F844.

Finish: Plain ASTM A153/A153M ASTM B695.

2.1.1.11 Anchor Rods

ASTM F1554ASTM A572/A572MASTM A36/A36MASTM A307.

- a. Configuration: Straight.
- b. Nuts: ASTM A563 heavy hex carbon steel.
- c. Plate Washers: ASTM A36/A36M carbon steel.
- d. Washers: ASTM F436/F436M hardened carbon steel.
- e. Finish: PlainHot-dip zinc coating, ASTM A153/A153M.

2.1.1.12 Threaded Rods

ASTM A193/A193MASTM A572/A572MASTM A36/A36MASTM A307.

- a. Nuts: ASTM A563MASTM A563 heavy hex carbon steel.
- b. Washers: ASTM F436/F436M hardened ASTM A36/A36M carbon steel.
- c. Finish: Plain Hot-dip zinc coating, ASTM A153/A153M Mechanically deposited zinc coating, ASTM B695.

2.1.13 Primer

SSPC-Paint 15, Type I, red oxide.

2.2 FABRICATION

2.2.1 General

Comply with MBMA MBSM - "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."

2.3 STRUCTURAL FRAMING

2.3.1 General

Clean all framing members to remove loose rust and mill scale. Provide 1 shop coat of primer to an average dry film thickness of 1 mil according to SSPC SP 2. Balance of painting and coating procedures must conform to SSPC Paint 15 and SSPC Painting Manual.

2.3.2 Primary Framing

Manufacturer's standard structural primary framing system includes transverse and lean-to frames; rafter, rakes, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing designed to withstand required loads and specified requirements. Provide frames with attachment plates, bearing plates, and splice members. Provide frame span and spacing indicated.

Shop fabricate framing components by welding or by using high-strength bolts to the indicated size and section with base-plates, bearing plates, stiffeners, and other items required. Cut, form, punch, drill, and weld framing for bolted field erection.

- a. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
- b. Frame Configuration: Single gable.
- c. Exterior Column Type: Tapered.
- d. Rafter Type: Tapered.

2.3.3 Secondary Framing

Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet pre-painted with coil coating, unless otherwise indicated.

Shop fabricate framing components by roll-forming or break-forming to the indicated size and section with base-plates, bearing plates, stiffeners, and other plates required for erection. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

- a. Purlins: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; minimum depth as required to comply with system performance requirements.
- b. Girts: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange minimum depth as required to comply with system performance requirements.
- c. Eave Struts: Unequal-flange, C-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.
- d. Flange Bracing: Structural-steel angles or cold-formed structural tubing to stiffen primary frame flanges.
- e. Sag Bracing: Structural-steel angles.
- f. Base or Sill Angles: Zinc-coated (galvanized) steel sheet.
- g. Purlin and Girt Clips: Steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
- h. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from zinc-coated (galvanized) steel sheet structural-steel sheet.
- i. Framing for Openings: Channel shapes; fabricated cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.
- j. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

2.3.4 Bracing

Provide adjustable wind bracing as follows:

- a. Rods: ASTM A36/A36M; ASTM A572/A572M; or ASTM A529/A529M threaded full length or threaded a minimum length at each end as determine by the designer.
- b. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
- c. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
- d. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates

or structural-steel shapes to match primary framing; of size required to withstand design loads.

- e. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
- f. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.

2.4 PANEL MATERIALS

2.4.1 Steel Sheet

Roll-form steel roof, wall and liner panels to the specified profile, with gauge and depth as indicated. Steel sheets must contain a minimum recycled content of 25 percent. Provide data identifying percentage of recycled content for steel sheet materials. Material must be plumb and true, and within the tolerances listed:

- a. Galvanized Steel Sheet conforming to ASTM A653/A653M and AISI D100.
- b. Individual panels to have continuous length to cover the entire length of any unbroken roof slope with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.
- c. Provide panels with thermal expansion and contraction consistent with the type of system specified.

1. Interior liner panel to have a 'Box Rib' profile with exposed fasteners in valleys. Panel to be fastened to Metal Building System. Panel to be 36 inches wide by 1.25 inch deep. Fasteners to not project beyond depth of panel. Panel to have valleys at 12 inches on center and 2 stiffening ribs. Panels to have a smooth texture and prefinished to meet AAMA 621-02. Color to be selected from manufacturer standard color charts and chips. All trim to be provided by the metal liner panel manufacturer to match panel.

2. Metal roof panel to be standing seam type using mechanical crimping or snap together seams with concealed clips and fasteners. Panel to be fastened to Metal Building System. Gage to be determined by Metal Building System design and wind pressure requirements, min 24 gage. Width, profile, texture and color of standing seam to match adjacent Administration/Warehouse building. Prefinish to meet AAMA 621-02. All trim to be provided by metal roof panel manufacturer to match panel.

3. Metal wall panel to be insulated type with concealed clips and fasteners. Panel to be fastened to Metal Building System. Panel to be 36 inch wide with flush joints. Steel facer to be min 22 gage. Panel thickness determined by required thermal value as indicated on drawings. Exposed surfaces of panel to be flat with embossed texture. Color to match wall panel color on Administration/Warehouse building as indicated on drawing elevations. Prefinish to meet AAMA 621-02. All trim to be provided by metal wall panel manufacturer to match panel.

2.4.2 Foam-Insulation Core Wall Panel

Provide factory-formed steel wall panel assembly fabricated from two sheets of metal with modified polyisocyanurate foam insulation core board during fabrication with joints between panels designed to form weather-tight seals. Include accessories required for weather-tight installation.

- a. Closed-Cell Content: 90 percent when tested according to ASTM D6226, ASTM C1289.
- b. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D1622/D1622M.
- c. Compressive Strength: Minimum 20 psi when tested according to ASTM D1621.
- d. Shear Strength: 26 psi when tested according to ASTM C273/C273M.

2.4.3 Finish

All panels are to receive a factory-applied polyvinylidene fluoride of Kynar 500/Hylar 5000 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

- a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.
- b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. This prime coat must be oven cured prior to application of finish coat.
- c. Exterior Finish Coating: Apply the finish coating over the primer by roll coating to dry film thickness of 0.80 plus 0.05 mils for a total dry film thickness of 1.00 plus 0.10 mils. This finish coat must be oven-cured.
- d. Interior Finish Coating: Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. The wash-coat must be oven-cured.
- e. Color: As indicated on drawings. Manufacturer to provide color chips.
- f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

Chalking: ASTM DEFONLINE

Color Change and Conformity: ASTM D2244

Weatherometer: ASTM G152, ASTM G153 and ASTM D822

Humidity: ASTM D2247 and ASTM D714

Salt Spray: ASTM B117

Chemical Pollution: ASTM D1308

Gloss at 60 degrees: ASTM D523

Pencil Hardness: ASTM D3363
Reverse Impact: ASTM D2794
Flexibility: ASTM D522/D522M
Abrasion: ASTM D968
Flame Spread: ASTM E84

2.4.4 Repair Of Finish Protection

Repair paint for enameled metal panel must be compatible paint of the same formula and color as the specified finish furnished by the metal panel manufacturer, conforming to ASTM A780/A780M.

2.5 MISCELLANEOUS METAL FRAMING

2.5.1 General

Cold-formed metallic-coated steel sheet conforming to ASTM A653/A653M and specified in Section 05 40 00 COLD-FORMED METAL FRAMING unless otherwise indicated.

2.5.2 Fasteners for Miscellaneous Metal Framing

Refer to the following paragraph FASTENERS.

2.6 FASTENERS

2.6.1 General

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties required to fasten miscellaneous metal framing members to substrates in accordance with the metal panel manufacturer's and ASCE 7-16 requirements.

2.6.2 Exposed Fasteners

Fasteners for metal panels to be corrosion resistant coated steel, aluminum, stainless steel, or nylon capped steel compatible with the sheet panel or flashing and of a type and size recommended by the manufacturer to meet the performance requirements and design loads. Fasteners for accessories to be the manufacturer's standard. Provide an integral metal washer matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick.

2.6.3 Screws

Screws to be corrosion resistant coated steel, aluminum or stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.6.4 Rivets

Rivets to be closed-end type, corrosion resistant coated steel, aluminum or stainless steel where watertight connections are required.

2.6.5 Attachment Clips

Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A653/A653M or Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load

criteria specified.

2.7 FRAMES AND MATERIALS FOR OPENINGS

2.7.1 Doors

Fire-Rated and Non-Fire-Rated Door Assemblies conforming with NFPA 80 and based on testing according to NFPA 252 as specified in Division 08 - OPENINGS unless otherwise indicated.

2.8 ACCESSORIES

2.8.1 General

All accessories to be compatible with the metal panels; sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the metal panels. Exposed metal accessories/finishes to match the panels, except as otherwise indicated. Molded foam rib, ridge and other closure strips to be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

2.8.2 Roof and Wall Accessories and Specialties

Equipment supports, roof ridge ventilators, wall louvers and other miscellaneous roof and wall equipment or penetrations conforming to AAMA, ASTM, and UL as specified in Division 07 unless otherwise indicated.

2.8.3 Insulation

Faced, Glass-Fiber Blanket Insulation: ASTM C665, Type II, blankets with non-reflecting coverings; Class A, membrane-faced surface with a flame spread of 25 or less tested in accordance with ASTM E84. Provide insulation materials containing the following minimum percentage of recycled content by weight: 20 percent glass cullet complying with ASTM D5359. Provide data identifying percentage of recycled content for insulation materials.

2.8.3.1 Polyethylene Vapor Retarder

Vapor retarder to be a part of the roof insulation system.

Install polyethylene vapor retarder membrane over entire roof surface. Use fully compatible polyethylene tape to seal the edges of the sheets to provide a vapor tight membrane. Lap sheets not less than 6 inch. Provide sufficient material to avoid inducing stresses in sheets due to stretching or binding. All tears or punctures visible in the finished surface, at any time during the construction process, must be sealed with polyethylene tape.

2.8.3.2 Wall Liner

Securely fasten wall liner into place in accordance with the manufacturer's recommendation and in a neatly presented appearance.

2.8.4 Rubber Closure Strips

Closed-cell, expanded cellular rubber conforming to ASTM D1056 and ASTM D1667; extruded or molded to the configuration of the specified metal

panel and in lengths supplied by the metal panel manufacturer.

2.8.5 Metal Closure Strips

Factory fabricated closure strips to be the same material, thickness, color, finish and profile of the specified panel.

2.8.6 Joint Sealants

2.8.6.1 Sealants

Sealants are to be an approved gun type for use in hand or air-pressure caulking guns at temperatures above 40 degrees F (or frost-free application at temperatures above 10 degrees F with minimum solid content of 85 percent of the total volume. Sealant is to dry with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Prime all joints to receive sealants with a compatible one-component or two-component primer as recommended by the metal panel manufacturer.

2.8.6.2 Shop-Applied

Sealant for shop-applied caulking must be an approved gun grade, non-sag one component polysulfide or silicone conforming to ASTM C920, Type II, and with a curing time to ensure the sealant's plasticity at the time of field erection.

2.8.6.3 Field-Applied

See Section 07 92 00 JOINT SEALANTS for sealant requirements.

2.8.6.4 Tape Sealant

Pressure sensitive, 100 percent solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the metal panel manufacturer.

2.9 Snow Guard System

Provide an aluminum snow retention system perpendicular to the slope of the roof consisting of a continuous guard bar, provided in longest practical lengths, mechanically attached clips to standing seam ribs and snow clips between clips to further prevent falling snow and ice. Design system to meet snow loads as indicated on drawings. Continuous rectangular snow guard bar to be prefinished to match metal roof panels. Roof warranty shall not be effected by snow guard system.

2.10 SHEET METAL FLASHING AND TRIM

2.10.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning,

buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.11 FINISHES

2.11.1 General

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

2.11.2 Appearance of Finished Work

Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

Before erection proceeds, examine with the erector present, the concrete foundation dimensions, concrete and masonry bearing surfaces, anchor bolt size and placement, survey slab elevation, locations of bearing plates, and other embedments to receive structural framing with the metal building manufacturer's templates and drawings before erecting any steel components for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

Examine primary and secondary framing to verify that rafters, purlins, angles, channels, and other structural and metal panel support members and anchorages have been installed within alignment tolerances required by metal building manufacturer, UL, ASTM, ASCE 7-16 and as required by the building code for the geographical area where construction will take place.

Examine roughing-in for components and systems penetrating metal roof or wall panels to verify actual locations of penetrations relative to seam locations of metal panels before metal roof or wall panel installation.

Submit to the Contracting Officer a written report, endorsed by Erector, listing conditions detrimental to performance of the Work.

Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Provide temporary shoring, guys, braces, and other supports during erection to keep the structural framing secure, plumb, and in alignment against temporary construction loading or loads equal in intensity of the building design loads. Remove temporary support systems when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment and performance.

Miscellaneous Framing: Install sub-purlins, girts, angles, furring, and other miscellaneous support members or anchorage for the metal roof or wall panels, doors, windows, roof curbs, ventilators and louvers according to metal building manufacturer's written instructions.

3.3 ERECTION OF STRUCTURAL FRAMING

Erect metal building system according to manufacturer's written erection instructions, approved shop drawings and other erection documents in accordance with MBMA MBSM - "Metal Building Systems Manual".

Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer and the Contracting Officer.

Set structural framing accurately in locations and to elevations indicated and according to AISC 325 specifications. Maintain structural stability of frame during erection.

Clean and roughen concrete and masonry bearing surfaces prior to setting plates. Clean bottom surface of plates.

Align and adjust structural framing before permanent bolt-up and connections. Perform necessary adjustments and alignment to compensate for changes or discrepancies in elevations.

Maintain erection tolerances of structural framing in accordance with AISC 360.

3.4 METAL WALL PANEL INSTALLATION

Provide metal wall panels of full length from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, in accordance with MBMA MBSM.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting metal wall panels by torch is not permitted.

3.5 ROOF PANEL INSTALLATION

Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place in accordance with NRCA RoofMan and MBMA MBSM.

Erect roofing system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated rake and eave overhang.

Work must allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure.

Field cutting metal roof panels by torch is not permitted.

Roofing sheets must be laid with corrugations in the direction of the roof slope. End laps of exterior roofing must not be less than 8 inches; the side laps of standard exterior corrugated sheets must be not less than 2-1/2 corrugations.

Do not permit storage, walking, wheeling, or trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of roof construction.

3.6 METAL PANEL FASTENER INSTALLATION

Anchor metal panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.7 FLASHING, TRIM AND CLOSURE INSTALLATION

- a. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- b. Sheet metalwork is to be accomplished to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

3.8 DOOR AND FRAME INSTALLATION

Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturer's written instructions. Coordinate installation with metal panel flashings and other components. Caulk and seal perimeter of each door frame with elastomeric sealant compatible with metal panels. Comply with installation requirements in Division 08 - OPENINGS.

3.9 ACCESSORY INSTALLATION

3.9.1 General

Install accessories with positive anchorage to building and weather-tight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

3.9.2 Dissimilar Metals

Where dissimilar metals contact one another or corrosive substrates are present, protect against galvanic action by painting dissimilar metal surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each surface, or by other permanent separation techniques as recommended by the metal building manufacturer.

3.9.3 Gutters and Downspouts

Comply with performance requirements, manufacturer's written installation instructions, and install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA 1793 recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

3.9.4 Insulation

Comply with performance requirements and manufacturer's written installation instructions. Install insulation concurrently with metal panel installation, in thickness indicated to cover entire roof and wall area, as specified in Division 07 - THERMAL AND MOISTURE PROTECTION.

3.9.5 Roof and Wall Accessories and Specialties

Install roof and wall accessories and specialties complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports as specified in Division 07 - THERMAL AND MOISTURE PROTECTION, unless otherwise indicated.

3.10 CLEAN-UP AND PROTECTION

3.10.1 Structural Framing

Clean all exposed structural framing at completion of installation. Remove metal shavings, filings, bolts, and wires from work area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.10.2 Metal Panels

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove protective coverings/films, grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.10.3 Touch-Up Painting

After erection, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories. Clean and touch-up paint as specified in Section 09 90 00 PAINTS AND COATINGS, unless otherwise indicated.

3.11 WASTE MANAGEMENT

Dispose of construction waste in accordance with the requirements of Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

3.12 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Perform special inspections and testing for seismic-resisting systems and components in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

3.13 WARRANTY

3.13.1 Manufacturer's Warranty

Submit all manufacturers' signed warranties to Contracting Officer prior to final commissioning and acceptance.

3.13.2 Contractor's Warranty For Installation

Submit warranty for installation to the Contracting Officer prior to final commissioning and acceptance.

3.13.3 Contractor's Five Year No Penal Sum Warranty

CONTRACTOR'S FIVE YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM

FACILITY DESCRIPTION: _____

BUILDING NUMBER: _____

CORPS OF ENGINEERS CONTRACT NUMBER: _____

CONTRACTOR

CONTRACTOR: _____

ADDRESS: _____

POINT OF CONTACT: _____

TELEPHONE NUMBER: _____

OWNER

OWNER: _____

ADDRESS: _____

POINT OF CONTACT: _____

TELEPHONE NUMBER: _____

CONSTRUCTION AGENT

CONSTRUCTION AGENT: _____

ADDRESS: _____

POINT OF CONTACT: _____

—
TELEPHONE NUMBER: _____

CONTRACTOR'S FIVE YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(continued)

THE METAL BUILDING SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY _____ FOR A PERIOD OF FIVE _____ YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE AND STRUCTURAL FAILURE WITHIN PROJECT SPECIFIED DESIGN LOADS, AND LEAKAGE. THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY INCLUDES, BUT IS NOT LIMITED TO, THE FOLLOWING:

FRAMING AND STRUCTURAL MEMBERS, ROOFING AND SIDING PANELS AND SEAMS, INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS, ACCESSORIES, TRIM, FLASHINGS AND MISCELLANEOUS BUILDING CLOSURE ITEMS SUCH AS DOORS AND WINDOWS (WHEN FURNISHED BY THE MANUFACTURER), CONNECTORS, COMPONENTS, AND FASTENERS, AND OTHER SYSTEM COMPONENTS AND ASSEMBLIES INSTALLED TO PROVIDE A WEATHERTIGHT SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THESE SPECIFICATIONS THAT BECOME PART OF THE METAL BUILDING SYSTEM.

ALL MATERIAL AND WORKMANSHIP DEFICIENCIES, SYSTEM DETERIORATION CAUSED BY EXPOSURE TO THE ELEMENTS OR INADEQUATE RESISTANCE TO SPECIFIED SERVICE DESIGN LOADS, WATER LEAKS AND WIND UPLIFT DAMAGE MUST BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE AND LEAKAGE ASSOCIATED WITH THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY MUST BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER.

THIS WARRANTY COVERS THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON _____ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

(Company President)

(Date)

CONTRACTOR'S FIVE YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(continued)

THE CONTRACTOR HEREBY SUPPLEMENTS THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE METAL BUILDING SYSTEM, WHICH IS SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR IS ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).
2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.
3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.
4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.
5. FAILURE OF ANY PART OF THE BUILDING SYSTEM DUE TO ACTIONS BY THE OWNER WHICH INHIBIT FREE DRAINAGE FROM THE ROOF, GUTTERS AND DOWNSPOUTS; OR CONDITIONS WHICH CREATE PONDING WATER ON THE ROOF OR AGAINST THE BUILDING SIDING.
6. THIS WARRANTY APPLIES TO THE METAL BUILDING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.
7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR AND THIS WARRANTY AND THE CONTRACT PROVISIONS TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES. REPORTS OF LEAKS AND BUILDING SYSTEM DEFICIENCIES MUST BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE BY TELEPHONE OR IN WRITING FROM EITHER THE OWNER, OR CONTRACTING OFFICER. EMERGENCY REPAIRS, TO PREVENT FURTHER ROOF LEAKS, MUST BE INITIATED IMMEDIATELY; A WRITTEN PLAN MUST BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSSMR SYSTEM WITHIN SEVEN CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT MUST BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED

CONTRACTOR'S FIVE YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(Exclusions from Coverage Continued)

POST A FRAMED COPY OF THIS WARRANTY IN THE MECHANICAL ROOM OR OTHER APPROVED
LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

SECTION 13 48 73

SEISMIC CONTROL FOR MECHANICAL EQUIPMENT
05/20, CHG 1: 08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

- | | |
|-----------|--|
| ACI 355.2 | (2007) Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary |
| ACI 355.4 | (2011) Qualification of Post-Installed Adhesive Anchors in Concrete (ACI 355.4) and Commentary |

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

- | | |
|----------|----------------------------------|
| AISC 325 | (2017) Steel Construction Manual |
|----------|----------------------------------|

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

- | | |
|-----------|--|
| ASCE 7-05 | (2005) Minimum Design Loads and Associated Criteria for Buildings and Other Structures |
|-----------|--|

ASTM INTERNATIONAL (ASTM)

- | | |
|-----------------|--|
| ASTM A36/A36M | (2019) Standard Specification for Carbon Structural Steel |
| ASTM A53/A53M | (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A153/A153M | (2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A325 | (2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength |
| ASTM A490 | (2014a) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength |
| ASTM A500/A500M | (2021a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |

ASTM A563 (2015) Standard Specification for Carbon and Alloy Steel Nuts

ASTM A603 (2019) Standard Specification for Zinc-Coated Steel Structural Wire Rope

ASTM F1554 (2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC ES AC156 (2012) Acceptable Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

METAL FRAMING MANUFACTURERS ASSOCIATION (MFMA)

MFMA-4 (2004) Metal Framing Standards Publication

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2019) Structural Engineering

UFC 3-301-02 (2020) Design of Risk Category V Structures, National Strategic Military Assets

UFC 4-010-01 (2018; with Change 1, 2020) DoD Minimum Antiterrorism Standards for Buildings

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION (VISCMA)

VISCMA 412 (2014) Installing Seismic Restraints for Mechanical Equipment

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Apply the requirements for seismic protection measures, described in this section and on the drawings, of the miscellaneous equipment and systems listed below, in accordance with UFC 3-301-01 and additional data furnished by the Contracting Officer. Provide seismic protection measures in addition to any other requirements called for in other sections of these specifications. Where there is a conflict between the specifications and the drawings, the specifications will take precedence. Accomplish resistance to lateral forces induced by earthquakes without consideration of friction resulting from gravity loads.

1.2.2 Miscellaneous Equipment and Systems

Provide bracing and attachment for the following miscellaneous equipment

located on the Pier and components developed by the Contractor in accordance with the requirements of this specification:

Equipment/Components with $I_p = 1.5$ (Designated Seismic Systems)
Insert edited list here similar to one above for $I_p = 1.0$

- Light Fixtures and Poles
- Unit Substation (Primary, Transformer and Secondary Distribution)
- Meters
- 600V Power Connection Stations
- Conduits
- Control Panels
- Outdoor Telecommunications Enclosures

1.2.3 Mechanical Systems

Mechanical systems located on the Pier to be seismically protected must include the following items to the extent required on the drawings or in this or other sections of these specifications: MIL-STD-1625D Level 1. See structural drawings for load factors $I_p = 1.5$

- Potable Water Piping System
- Sanitary Sewer Piping System

1.2.4 Contractor Designed Bracing

Submit copies of the design calculations with the drawings. Calculations must be approved, certified, stamped and signed by a registered Professional Structural Engineer. Calculations must verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design the bracing in accordance with UFC 3-301-01, UFC 4-010-01 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes must be accomplished without consideration of friction resulting from gravity loads. UFC 3-301-01 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas must be required. Loadings determined using UFC 3-301-01 are based on strength design; therefore, AISC 325 Specifications must be used for the design. The bracing for the equipment designated in paragraph 1.2.2 and 1.2.3 must be developed by the Contractor.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bracing; G

Resilient Vibration Isolation Devices; G

Equipment Requirements; G

SD-03 Product Data

Bracing; G

Equipment Requirements; G

Anchor Bolts; G

Vibration Isolators; G

Snubbers; G

SD-05 Design Data

Design Calculations; G

SD-06 Test Reports

Anchor Bolts; G

SD-07 Certificates

ICC ES AC156 Shake Table Test; G

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

Submit detail drawings of bracing along with calculations, catalog cuts, templates, and erection and installation details, as appropriate, for the items listed in Paragraph 1.2.2. Indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction. Provide calculations and drawings that are stamped by a registered structural engineer, and that verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design must be based on actual equipment and system layout. Design must include calculated dead loads, static seismic loads and capacity of materials utilized for the connection of the equipment or system to the structure. Analysis must detail anchoring methods.

Include drawing for Designated Seismic System Equipment indicating the equipment location in the facility sufficient to be used for the installation. Equipment must be rigidly or flexibly mounted as indicated in the specifications and/or drawings depending on vibration isolation requirements as follows below. Roof mounted equipment both vibration isolated and nonisolated, must have support members designed and anchored to building structural steel or concrete as required for seismic restraint and wind loads.

2.1.1 Rigidly (Base and Suspended) Mounted Equipment

Equipment furnished under this contract must be rigidly mounted using cast-in-place anchor bolts to anchor them or post-installed anchors that are qualified for earthquake loading in accordance with ACI 355.2 and ACI 355.4. Anchor bolts must conform to ASTM F1554-07a¹. For any rigid equipment which is rigidly anchored, provide flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions. Suspended equipment bracing attachments should be located just above the center of gravity to minimize swinging. and Designated Seismic Systems (DSS) RC IV buildings assigned to Seismic Design Category Coefficient

(SDC) C, D, E, or F and Risk Category IV components needed for continued operation after an earthquake must have two nuts provided on each anchor bolt.

2.1.2 Nonrigid or Flexibly-Mounted Equipment

Select vibration isolation devices so that the maximum movement of equipment from the static deflection point is 1/4 inch. Equipment flexibly mounted on vibration isolators must have a bumper restraint or snubber in each horizontal direction and vertical restraints must be provided where require to resist overturning. Isolator housing and restraints must be constructed of ductile materials. A viscoelastic pad or similar material of appropriate thickness must be used between the bumper and components to limit the impact load. Restraints must be designed to resist the calculated horizontal lateral and vertical forces.

Spring vibration isolators must be seismically rated, restrained isolators for equipment subject to load variations and large external forces. The seismically rated housing must be sized to meet or exceed the force requirements applicable to the project and meet the required isolation criteria. Spring vibration isolator manufacturer's will be a member of VISCMA. Design force, F_p , must be doubled for vibration isolators with an air gap greater than 0.25 inches as specified in ASCE 7-05, Chapter 13.

2.2 BOLTS AND NUTS

Hex head bolts, and heavy hexagon nuts must be ASTM A325 or ASTM A490 bolts and ASTM A563 nuts. Provide bolts and nuts galvanized in accordance with ASTM A153/A153M when used underground or exposed to weather.

2.3 SWAY BRACING

Material used for members listed in this section and on the drawings, must be structural steel conforming with the following:

- a. Plates, rods, and rolled shapes, ASTM A36/A36M.
- b. Wire rope, ASTM A603.
- c. Tubes, ASTM A500/A500M, Grade B.
- d. Pipes, ASTM A53/A53M, Grade B.
- e. Angles, ASTM A36/A36M.
- f. Channels (Struts) with in-turned lips and associated hardware for fastening to channels at random points conforming to MFMA-4.

PART 3 EXECUTION

3.1 BRACING

Provide bracing conforming to the arrangements shown. Install cables at a 45-degree slope. Where interference is present, the slope may be minimum of 30 degrees or a maximum of 60 degrees per VISCMA 412.

3.2 BUILDING DRIFT

Do not attach sway braces for equipment to two dissimilar structural

elements of a building that may respond differentially during an earthquake unless a flexible joint is provided. Bracing must be capable of accommodating building drift due to seismic displacements.

3.3 ANCHOR BOLTS

3.3.1 General

Submit copies of test results to verify the adequacy of the specific anchor and application, as specified.

Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices allowing adequate edge distance and embedment depth for restraint anchor bolts. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Install neoprene grommet washers or till the gap with epoxy on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 0.125 inches.

3.3.2 Cast-In-Place

Use templates to locate cast-in-place bolts accurately and securely in formwork. Provide anchor bolts with an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads must either extend into concrete floor or the foundation or be increased in depth to accommodate bolt lengths. Use templates to locate cast-in-place bolts accurately and securely in formwork.

3.3.3 Drilled-In Anchor Bolts

Drill holes with rotary impact hammer drills. Drill bits must be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the drawings, all holes must be drilled perpendicular to the concrete surface. Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the COR if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines. Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Perform anchor installation in accordance with manufacturer instructions. For Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut Anchors, protect threads from damage during anchor installation. Heavy-duty sleeve anchors must be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10 percent of the specified torque, 100 percent of the specified torque must be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor must be removed and replaced unless otherwise directed by the Engineer.

For Cartridge Injection Adhesive Anchors where approved for seismic application, clean all holes per manufacturer instructions to remove loose

material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive must be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed. For Capsule Anchors where approved for seismic application, perform drilling and setting operations in accordance with manufacturer instructions. Clean all holes to remove loose material and drilling dust prior to installation of adhesive. Remove water from drilled holes in such a manner as to achieve a surface dry condition. Capsule anchors must be installed with equipment conforming to manufacturer recommendations. Do not disturb or load anchors before manufacturer specified cure time has elapsed. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

3.3.4 Anchor Bolt Testing

Test in place expansion and chemically bonded anchors not more than 24 hours after installation of the anchor, conducted by an independent testing agency; testing must be performed on random anchor bolts as described below.

3.3.4.1 Torque Wrench Testing

Perform torque wrench testing on not less than 50 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque must equal the minimum required installation torque as required by the bolt manufacturer. Calibrate torque wrenches at the beginning of each day the torque tests are performed. Recalibrate torque wrenches for each bolt diameter whenever tests are run on bolts of various diameters. Apply torque between 20 and 100 percent of wrench capacity. Reach the test torque within one half turn of the nut, except for 3/8 inch sleeve anchors which must reach their torque by one quarter turn of the nut. If any anchor fails the test, test similar anchors not previously tested until 20 consecutive anchors pass. Failed anchors must be retightened and retested to the specified torque; if the anchor still fails the test it must be replaced.

3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, select anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations that follow the same procedure as in paragraph ANCHOR BOLTS, except use an equipment weight equal to five times the actual equipment weight.

3.4.1 Spring-Type Vibration Devices

Select vibration isolation devices so that the maximum movement of equipment from the static deflection point is 1/2 inch. Equipment flexibly mounted on vibration isolators must have a bumper restraint or snubber in each horizontal direction and vertical restraints must be provided where required to resist overturning. Isolator housing and restraints must be constructed of ductile materials. A viscoelastic pad or

similar material of appropriate thickness must be used between the bumper and components to limit the impact load. Restraints must be designed to resist the calculated horizontal lateral and vertical forces.

Spring vibration isolators must be seismically rated, restrained isolators for equipment subject to load variations and large external forces. The seismically rated housing must be sized to meet or exceed the force requirements applicable to the project and meet the required isolation criteria. Spring vibration isolator manufacturers will be a member of VISCMA.

3.4.2 Multidirectional Seismic Snubbers

Install multidirectional seismic snubbers employing elastomeric pads on floor- or slab-mounted equipment. Use snubbers that provide 1/4 inch free vertical and horizontal movement from the static deflection point. Provide snubber medium consisting of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

3.5 EQUIPMENT SWAY BRACING

3.5.1 Suspended Equipment

Provide equipment sway bracing for items supported from floor, overhead floor or roof structural systems. Provide braces that consist of angles, rods, wire rope, bars, channels (struts) or pipes arranged as shown in bracing submittals and secured at both ends with not less than 1/2 inch bolts. Provide sufficient braces for equipment to resist a horizontal force as specified in UFC 3-301-01 without exceeding safe working stress of bracing components. Provide, for approval, specific force calculations in accordance with UFC 3-301-01 for the equipment in the project. Submit details of equipment bracing for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.5.2 Floor or Pad Mounted Equipment

3.5.2.1 Shear Resistance

Bolt to the floor, floor mounted equipment. Provide the number and installation of bolts to resist shear forces in accordance with paragraph ANCHOR BOLTS.

3.5.2.2 Overturning Resistance

Use the ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads to determine if overturning forces need to be considered in the sizing of anchor bolts. Provide calculations to verify the adequacy of the anchor bolts for combined shear and overturning.

3.6 SPECIAL TESTING FOR SEISMIC-RESISTING EQUIPMENT

Equipment and components designated as MC-1 (Mission Critical Level 1) Designated Seismic Systems required to remain operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. This applies to all Pier systems mentioned in this section and in others. The manufacturer is to provide a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise. Seismic component qualification documentation for each piece of equipment must contain the information required in UFC 3-301-02, Section 2-17.2.5 Component Qualification Documentation.

Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be less than 5 inches x 7 inches with red letters 1 inch in height on a white background stating "Certified Equipment." The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file." The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

3.7 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS AND EQUIPMENT

Perform special inspections for seismic-resisting systems, equipment and components designated seismic systems and equipment per ICC IBC 1705.12.4; and storage racks per ICC IBC 1705.12.7. Periodic special inspections will be conducted on miscellaneous equipment as required by Section 1705.12 of the International Building Code and paragraph 2-2.4.3 of UFC 3-301-01. Provide a Statement of Special Inspections and Final Report in accordance with paragraph 2-2.4.3 of UFC 3-301-01.

-- End of Section --

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SECTION 14 24 23

HYDRAULIC PASSENGER ELEVATORS

05/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A17.1/CSA B44	(2021) Safety Code for Elevators and Escalators
ASME A17.2	(2017) Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, and Escalators and Moving Walks
ASME B16.9	(2018) Factory-Made Wrought Butt welding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
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ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M	(2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
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INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code
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NATIONAL ELEVATOR INDUSTRY, INC. (NEII)

NEII-1 (2000; R thru 2017) Building
Transportation Standards and Guidelines,
including the Performance Standards Matrix
for New Elevator Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 70E (2021) Standard for Electrical Safety in
the Workplace

NFPA 72 (2022) National Fire Alarm and Signaling
Code

NFPA 101 (2021) Life Safety Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-560-01 (2017, with Change 2, 2019) Operations and
Maintenance: Electrical Safety

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 Americans with Disabilities Act (ADA)
Accessibility Guidelines for Buildings and
Facilities; Architectural Barriers Act
(ABA) Accessibility Guidelines

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are for Contractor Quality Control
approval. Submittals with an "S" are for inclusion in the Sustainability
eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING.
Submit the following in accordance with Section 01 33 00 SUBMITTAL
PROCEDURES:

SD-02 Shop Drawings

Elevator System; G

Elevator Components; G

Elevator Machine; G

Elevator Controller; G

Wiring Diagrams; G

SD-03 Product Data

Elevator and Accessories; G

Elevator Components; G

Data Sheets; G

Elevator Microprocessor Controller; G

SD-05 Design Data

Emergency Power Systems

Heat Loads

Reaction Loads

SD-07 Certificates

Elevator Parts and Components Price Lists; G

Warranty

Endorsement Letter

Welders' Qualifications

Elevator Controller Certification; G

SD-10 Operation and Maintenance Data

Elevator, Data Package 4; G

Maintenance Control Program (MCP); G

Software and Documentation; G

Submit in accordance with Section 01 78 23 OPERATION AND
MAINTENANCE DATA and 01 78 24.05 20 FACILITY OPERATION AND
MAINTENANCE SUPPORT INFORMATION.

1.2.1 Shop Drawing Requirements

Provide assembly and arrangement of elevators, accessories, and elevator components. Show location of elevator machine in elevator machine room (MR) or machinery space (MS). Show location of elevator controller in elevator machine room or elevator control room (CR). Provide details for materials and equipment, including but not limited to operating and signal fixtures, doors, door and car frames, car enclosure, controllers, motors, guide rails and brackets, layout of hoistway in plan and elevation, and other layout information and clearance dimensions.

1.2.2 Product Data Requirements

Provide manufacturers' product data for all elevator components, including but not limited to the following: elevator controller, hydraulic pump unit, hydraulic pump and motor, hydraulic cylinder, hydraulic piping and fittings, car and hall fixture buttons and switches, cab and machine room or control room communication devices, door operator, door protection system, car roller guides, and buffers. For data sheets, provide document identification number or bulletin number, published or copyrighted prior to the date of contract bid opening. Provide controller manufacturer's published procedures for performance of each and all testing required by

ASME A17.1/CSA B44.

1.2.3 Design Data

1.2.3.1 Reaction Loads

Provide calculations by registered professional engineer for reaction loads imposed on building by elevator system. Demonstrate calculations complying with ASME A17.1/CSA B44

1.2.3.2 Heat Loads

Provide calculations from elevator manufacturer, or by registered professional engineer, for total anticipated heat loads generated by all of the elevator equipment.

1.2.3.3 Emergency Power Systems

Where the facility does have an emergency power system, confirm the elevators that will be connected to the emergency power system. Confirm the complete emergency power system and sequence of operation for all elevators, including operation of the elevator lobby manual selection switch. Provide wiring diagrams for building emergency power interface with elevator controls. For elevators not supplied by an emergency power system, provide manufacturers' product data for auxiliary power systems.

1.2.4 Welders' Requirements

Comply with AWS D1.1/D1.1M, Section 5. Include certified copies of field welders' qualifications. List welders' names with corresponding code marks to identify each welder's welding work.

1.2.5 Maintenance Control Program (MCP)

For each elevator, prepare and provide a written Maintenance Control Program (MCP) that complies with ASME A17.1/CSA B44 Section 8.6, including written documentation that details the test procedures for each and every test that is required to be performed by ASME A17.1/CSA B44. Assemble all MCP documentation, and supporting technical attachments, in a single MCP package and provide in both electronic and hard copy. Assemble entire hard copy MCP in 3-ring binders. For each elevator provided, the MCP must include only documentation and instruction that apply to the elevator specified.

For each elevator, provide an additional, separate binder that includes all maintenance, repair, replacement, call back, and other records required by ASME A17.1/CSA B44. The records binder must be kept in the elevator mechanical room, maintained by elevator maintenance and service personnel, and be available at all times to authorized personnel.

Provide detailed information regarding emergency service procedures and elevator installation company personnel contact information. Provide a listing of all tools to be provided to the Contracting Officer as components of the elevator system.

1.3 QUALITY ASSURANCE

1.3.1 Qualification

Provide a designed and engineered elevator system by an elevator contractor regularly engaged in the installation of elevator systems. Provide elevator components manufactured by companies regularly engaged in the manufacture of elevator components. Utilize only licensed and certified elevator personnel for the installation, adjusting, testing, and servicing of the elevators.

1.3.1.1 Elevator Contractor's Elevator Technicians

For elevator installations in the United States, including United States territories, perform all elevator related work under the direct guidance of a state certified elevator technician with a minimum of three years of experience in the installation of elevator systems of the type and complexity specified in the contract documents. Provide an endorsement letter from the elevator manufacturer, certifying that the elevator specialist is qualified. All elevator technicians must carry a current certification issued by one of the following organizations:

- a. National Association of Elevator Contractors (NAEC)
- b. National Elevator Industry Education Program (NEIEP)

1.3.2 Manufacturers' Technical Support

Provide elevator components from manufacturers that provide factory training and online and live telephone elevator technical support to any elevator installation, service, and maintenance contractor. Provide elevator components from manufacturers that guarantee accessibility to all replacement and repair parts and components to any elevator installation, service, and maintenance contractor. Use only elevator component manufacturers that provide current published price lists for all elevator parts and components.

1.3.3 Operation and Maintenance Data

Assemble all shop drawing and product data material into O&M Data Packages in accordance with Article SUBMITTALS. Provide two complete O&M Data Packages in hard copy and two complete electronic O&M data packages on separate CDs, in PDF format. Provide all O&M Data Packages to Contracting Officer. Include controller diagnostic documentation and software as required under Article CONTROL EQUIPMENT.

1.3.4 Wiring Diagrams

Provide complete wiring diagrams and sequence of operations, which show electrical connections and functions of elevator systems. Provide one set (11 inch by 17 inch minimum size) of wiring diagrams, with individual sheets laminated in plastic and assembled in binder, to be stored in the machine room or control room cabinet. Provide one additional hard copy set and two complete electronic sets on separate CDs, in PDF format. Provide all wiring diagram sets to the Contracting Officer. Coded diagrams are not acceptable unless fully identified.

1.3.5 Machine Room/Control Room Cabinet

For storage of O&M Data Packages and Wiring Diagrams, provide locking metal cabinet with a minimum size of 20 inch W by 12 inch D by 30 inch H. Cabinet must be sized large enough to accommodate all O&M Data and hardware required in paragraphs OPERATION AND MAINTENANCE DATA and WIRING DIAGRAMS. Secure cabinet to machine room or control room wall.

1.4 NEW INSTALLATION SERVICE

Provide elevator warranty service in accordance with the manufacturer's maintenance plan, warranty requirements and applicable safety codes, for a period of 12 months after the date of acceptance by Contracting Officer. Perform this work during regular working hours. Provide supplies and parts to keep elevator system in operation. Perform service only by factory trained personnel. Provide Monthly services to include repairs, adjustments, greasing, oiling, and cleaning. Provide service log in elevator machine room or control room and update Monthly, throughout the one-year warranty period.

Provide 24-hour emergency service, with one hour on-site response time, during this period without additional cost to the Government.

1.4.1 Periodic Elevator Certification Inspection and Testing

Provide elevator mechanic to support NAVFAC QEI Certified Elevator Inspector in the periodic six-month and the annual Category 1 elevator certification inspection and testing. Perform Category 1 inspection and testing no greater than 30 days prior to the end of the warranty period. Perform all elevator certification testing in the presence of QEI Certified Elevator Inspector.

In conjunction with the testing noted above, test systems for Emergency Power Operation, Earthquake Emergency Operation, and Hospital Emergency Commandeering Service Operation, as applicable. Schedule so that testing does not interfere with building operations.

1.5 FIRE PROTECTION SYSTEM

Coordinate interface between building fire protection system and elevator controls.

Additional fire protection requirements are located in: Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE; Section 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION; and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.5.1 Fire Alarm Initiating Devices

Fire alarm initiating devices are specified in Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE, including conduit and wiring from each detector to fire protection addressable modules in elevator machine room or control room.

1.5.2 Fire Sprinklers

Provide fire sprinklers in accordance with all applicable safety codes and with Section 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION. Provide shutoff valve, check valve, and non-adjustable, zero time-delay flow

switch, in each sprinkler line immediately outside of each machine room, control room, and hoistway, as applicable. Provide inspectors' test valve for periodic testing of flow switch and shunt trip disconnect.

Pipe sprinkler piping serving these spaces in a series manner with no laterals. Locate inspectors' test connection at the end of pipe runs such that operation of the test connection will purge air from system piping.

1.5.3 Shunt Trip Disconnect

Provide flow switches specified in paragraph FIRE SPRINKLERS to comply with ASME A17.1/CSA B44 and NFPA 72 for shunt trip of the main line power supply. For each elevator, provide control wiring connecting the flow switch to a shunt trip equipped circuit breaker located in the elevator machine room or control room. Upon flow of water, flow switch will instantaneously cause opening of the shunt-trip circuit breaker and remove power from the elevator. Flow switch must also send a signal to fire alarm control panel to indicate water flow condition.

PART 2 PRODUCTS

2.1 ELEVATOR DESCRIPTION

Provide elevator system that complies with ASME A17.1/CSA B44 in its entirety, ASME A17.2 in its entirety, and additional requirements specified herein. Provide elevator system that meets or exceeds the NEII-1 Ride Quality Performance Standards Matrix (RQPSM). Comply with the RQPSM "Intermediate Performance" criteria.

Provide and install elevators in accordance with 36 CFR 1191 - ABAAS, ICC IBC, IEEE C62.41, NFPA 70 and NFPA 101 requirements.

2.1.1 Elevator Design Parameters

2.1.1.1 Elevator - Emergency Medical Service Accessibility (EMSA)

Provide elevator(s) with minimum size and arrangement to accommodate an ambulance stretcher 24-inch by 84-inch with not less than 5-inch radius corners, in the open, horizontal position.

- a. Type: In-Ground Direct Plunger
- b. Rated load: 3500 lb.
- c. Rated Speed: 150 fpm
- d. Car Door Type: Single-speed side slide.
- e. Car Door Opening Width: 3 ft.-6 in. minimum.

2.1.2 Cab Enclosure and Hoistway Entrance Assemblies

Provide finishes as listed below:

- a. Floor; Resilient flooring as listed on drawing finish schedule.
- b. Walls; Plastic Laminate as listed on drawing finish schedule.

Wall trim; stainless steel.

c. Car doors, car door returns, and wall reveals; stainless steel.

d. Ceilings; anodized aluminum.

Ceiling frame; anodized aluminum.

e. Hoistway Entrance Assembly Material and Finishes; stainless steel.

2.2 ELEVATOR OPERATION

ASME A17.1/CSA B44, Introduction, Section 3, Definitions.

2.2.1 Single, Two-Stop, Automatic Operation

Provide Single Two-Stop Automatic Operation.

2.3 SPECIAL OPERATION AND CONTROL

Provide the following special operations and control systems.

2.3.1 Keys for Elevator Key Switches

Provide a minimum of twelve keys per unique cylinder used on all key switches for a single elevator. If there is more than one elevator, additional keys will not be required unless there are additional unique lock cylinders. Provide keys with brass or fiberglass tags marked "PROPERTY OF THE U.S. GOVERNMENT" on one side with function of key or approved code number on the other side.

2.3.2 Firefighters' Emergency Operation (FEO)

Provide FEO equipment and signaling devices. The designated level for the FEO Phase I key operated switch is the groundfloor. In the FEO Phase I fixture, provide FEO Operating Instructions.

2.3.2.1 Firefighters' Emergency Operation (FEO) Key Box

Provide flush mounted, locking, FEO Key Box of a minimum size of 5 inch W by 9 inch H by 1.5 inch D. Install at a height of 6 feet above floor level and directly above the FEO Phase I key switch. Provide box equipped with lock that uses the FEO K1 key.

2.3.3 Hoistway Access Operation

Provide hoistway access operation with switches at top and bottom terminal landings. Locate switch 6 feet above floor level, within 12 inches of elevator hoistway entrance frame or with the ferrule exposed when located in the elevator entrance frame.

2.3.4 In-Car Inspection Operation

Provide In-Car Inspection Operation.

2.3.5 Independent Service

Provide exposed key-operated switch in car operating panel to enable independent service and simultaneously disable in-car signals and landing-call responses. Provide indicator lights that automatically

illuminate during independent service. For duplex or group operation, if one car is removed from group another car will respond to its hall calls.

2.3.6 Selective Door Operation

For elevator with one or more rear openings at same level as front opening, provide full-selective operation with car and door operating buttons clearly marked for front and rear openings, front and rear car button for each such floor, and front and rear "DOOR OPEN" and "DOOR CLOSE" buttons. Only door for which the button was operated opens or closes.

2.3.7 Elevator Emergency Power Operation

Provide elevator emergency power operation. Coordinate power supply and control wiring to accomplish initiation and operation of elevators on emergency power.

2.4 ELEVATOR DRIVE SYSTEM

Provide hydraulic elevator drive system, including pump unit, piping, cylinder/plunger assembly, and associated equipment, which will operate at a maximum working pressure of 500 psi or less. Provide complete elevator system that meets or exceeds the NEII-1 Ride Quality Standard, including elevator ride quality and noise levels in car and in elevator machine room and machinery space.

2.4.1 Hydraulic Pump Unit

Provide self-contained pump unit, including oil-hydraulic elevator pump, electric motor, suction-line oil strainer, and structural steel outer base with tank supports and isolation pads. Provide oil tank capacity for full plunger displacement plus at least 10 gallons. Provide hydraulic pump unit manufacturer's standard hydraulic tank heater and cooler to maintain oil temperature between 100 and 130 degrees F regardless of ambient temperature. Limit acoustic output in elevator machine room and machinery space to 80 dbA.

2.4.1.1 Pump Motor

Provide intermittent-duty pump motor rated at 120 starts/hour. Provide motor that is sized so that the motor amperage does not exceed the motor data tag amperage in any operating condition, exclusive of acceleration and deceleration. Provide minimum of one mega ohm insulation resistance between conductors and motor frame. Provide motor and pump nameplate and data tags permanently mounted on the outside of the pump unit frame, with all data viewable without the use of mirrors or other tools.

2.4.1.2 Hydraulic Tank Heater

Provide immersion type in-tank heater rated 250 W at 120 VAC. Heater element must have a stainless steel main heater sheath and enclosure. Provide with a hardwired connection; do not provide a pre-terminated cord. Provide it with a preset thermostat set to maintain 100-degrees Fahrenheit. All fittings to be oil tight.

2.4.1.3 Hydraulic Cooler

Provide direct or remote mount oil cooler that can provide a minimum of

17,500 BTU/hr cooling capacity at 40-degrees Fahrenheit. Provide with adjustable thermostat, 10 micron oil filter, 8 GPM, 75PSI pump and all fittings and hardware. Provide the cooling fan with a minimum single phase ¼ HP, 120 VAC electric motor. Unit must not exceed 80 decibels at 3 feet from unit.

2.4.2 Hydraulic Controls and Equipment

Provide control valve, overspeed safety valve, blowout-proof muffler, and hydraulic pump discharge strainer in the hydraulic oil supply line. Provide two 1/4 turn, ball valve type manual shutoff valves. Provide one in the elevator hoistway pit and one in the elevator machine room or machinery space.

2.4.2.1 Hydraulic Control Valve

Provide constant-velocity, down-speed regulated, control valve. Down-speed regulated control valve allows the car to travel at the same speed in the down direction, regardless of the load on the elevator. In addition, the hydraulic control valve must have built-in adjustment capability to operate the elevator at 140 percent of rated speed to facilitate periodic testing of the overspeed safety valve.

2.4.2.2 Hydraulic Overspeed Safety Valve

Provide overspeed safety valve in hydraulic oil supply line, directly adjacent to the hydraulic cylinder. Provide threaded pipe connections between the hydraulic cylinder and the overspeed valve. Provide valve equipped with manufacturer's manual shutoff feature. Overspeed valve must not be equipped with a manual or automatic lowering feature. Provide adjustable valve with means to seal adjustment after inspection and testing by certified elevator inspector.

2.4.2.3 Hydraulic Oil Scavenger Pump

Provide a scavenge oil reservoir with oil return line, strainer and transfer pump in the elevator pit. The scavenger pump shall include a manual reset flood switch to prevent operation if the pit is flooded. Pump and reservoir shall be anchored to the pit floor.

2.4.3 Hydraulic Piping and Accessories

Provide ASTM A53/A53M or ASTM A106/A106M, Schedule 80, black steel piping with ASME B16.9 or ASME B16.11 fittings for supply piping. Extend schedule 80 piping from the pump control valve body, inside the pump unit, to the hydraulic cylinder in the hoistway. Provide welded or threaded forged pipe fittings for all fittings and components of the hydraulic oil supply line. For in-ground direct plunger cylinders, provide dielectric union or isolation couplings at each end of the hydraulic oil supply line. Provide hangers or supports for all piping and components.

2.4.3.1 Containment of Hydraulic Oil Supply Line

Protect all portions of hydraulic oil supply line that are installed below ground, including portions encapsulated in concrete or covered by construction, with continuous, Schedule 80, PVC. Inside diameter of PVC must be 3 inches larger than the outside diameter of the hydraulic oil supply line pipe and couplings.

2.4.4 Hydraulic Elevator Type

Provide a in-ground direct plunger type hydraulic elevator. Elevators with telescopic or inverted cylinder-plungers are not acceptable and may not be used. Rope hydraulic elevator design is not acceptable and may not be used.

2.4.4.1 Cylinder-Plunger (Jack) Unit

Provide a single-stage plunger of seamless steel construction. Provide cylinder with self-stabilizing mount that will support and hold cylinder plumb without the need for stabilization means at the bottom of the cylinder. Provide a threaded, 1/4 inch bleeder valve at the top of the cylinder, just below packing gland.

2.4.5 Cylinder Well System

For direct plunger, in-ground type hydraulic elevator, provide a dry, sealed cylinder well system.

2.4.5.1 Well Casing

Locate and drill well for the cylinder well system. Line well with steel casing, minimum 1/4 inch wall with welded 1/2 inch steel bottom. Set casing plumb.

2.4.5.2 PVC or HDPE Liner

Provide Schedule 80 PVC or HDPE liner with bottom cap and couplings; joints sealed watertight using pipe manufacturer's recommended adhesive or heat welding methods. Provide liner inside diameter not less than 3 inches larger than elevator cylinder maximum outside diameter. Liner may be provided as a cylinder manufacture's applied liner or as a separate component. For separate liner, set liner plumb in well casing, located for cylinder installation. Provide dry, salt-free sand below and around liner to top of well casing.

2.4.5.3 Cylinder Installation

Remove all moisture from inside of liner. Install cylinder plumb, inside liner. Provide a 1/4 inch copper evacuation tube inside the liner. The bottom of the evacuation tube must be within 6 inch of the bottom of the liner. Top of evacuation tube must extend at least 6 inch above pit floor. Provide top of test tube with removable cap to exclude foreign matter. Provide air inlet pressure fitting in top of liner and accessible in pit, for performance of air pressure test. Secure Liner/Cylinder Assembly as recommended by cylinder manufacturer.

2.4.5.4 Cylinder Liner Moisture Sensor System

Provide moisture and oil sensors inside the cylinder liner for detection of oil and water at the bottom of the cylinder liner. Provide sensor monitoring system that will actuate audible and visual alarms and identify the presence of water and identify the presence of oil inside the liner.

2.4.5.5 Seal Top of Well Casing

Upon successful test and certification of Liner/Cylinder assembly, seal gap between steel well casing and liner with foam insert strong enough to

retain and support final grouting. Provide 3000 psi grout to a minimum of 4 inch thickness and level top of final grouting with pit floor.

2.5 CONTROL EQUIPMENT

Enclose all elevator control equipment in factory-primed and baked-enamel coated sheet-metal cabinets with ventilation louvers and removable or hinged doors. Mount cabinets at a height of 10 inches above machine room or control room finish floor.

2.5.1 Motor Control Equipment

Provide elevator motor control with electronic, soft-start motor starter.

2.5.2 Elevator Microprocessor Controller

For each individual elevator controller, and for each group controller, provide a microprocessor controller that complies with the following paragraphs. Provide controller(s) package that includes all hardware and software required for the installation, maintenance, and service of the elevator, in its' entirety. Provide verification of technical support service that the controller manufacturer provides to any licensed elevator installation, service, and maintenance company.

Provide an elevator controller from a manufacturer that provides comprehensive factory training to include controller installation, adjustment, service, and maintenance. The training must be identified as available to any licensed elevator contractor. Provide verification of an established and documented training schedule, with pricing, for factory training classes that manufacturer has provided for a minimum period of one year prior to contract award date.

The elevator controller must be identified as available for purchase and installation by any licensed elevator contractor. All components, parts, diagnostic tools, and software must be available for purchase and installation and use by any licensed elevator contractor; "exchange-only" provisions for the purchase of spare parts are not acceptable. The elevator controller manufacturer must publish an industry competitive price listing for all controller parts, diagnostic tools, and software.

Provide verification of telephone and internet based technical support service that the elevator controller manufacturer provides to any licensed elevator installation, service, and maintenance company at an industry competitive price. The service must include live telephone based technical support for installation, adjustment, maintenance, and troubleshooting of the elevator controller and related elevator components. The service must be available during standard working hours.

Provide an elevator controller that is designed to automatically reestablish normal elevator operation following any temporary loss of power, regardless of duration.

2.5.2.1 Elevator Controller Interface Cabinet

For each individual elevator microprocessor controller, provide a separate elevator control cabinet with an integrated human interface system. For group elevator installations, a single cabinet and interface system with full access to each elevator controller may be utilized. The separate controller interface cabinet must be supplied by the elevator controller

manufacturer and include a minimum 12 inch wide keyboard and a minimum 10 inch monitor. The elevator controller interface cabinet must comply with arc-flash protection requirements of NFPA 70E and UFC 3-560-01.

2.5.2.1.1 Elevator Microprocessor Human Interface

The interface system must provide complete elevator controller interface capability and must include the elevator controller manufacturer's comprehensive package of installation and diagnostic software. The microprocessor interface system must provide unrestricted access to all parameters, all levels of adjustment, and all flags necessary for installation, adjustment, maintenance, and troubleshooting of each elevator and for the elevator group. All software programming must be stored in non-volatile memory. The elevator controller fault log must provide non-volatile memory fault log storage of all faults, trouble calls, and fault history for a minimum of one year and the ability to download or print the fault log. The controller interface must also provide the capability to display and diagnose trouble calls, faults, and shutdowns. Expiring software, degrading operation, and "key" access controls are not acceptable.

2.5.2.2 Software and Documentation

Provide three copies of the manufacturer's maintenance and service diagnostic software, with complete software documentation, that will enable the same level of unrestricted access to all controllers of the same make and model, regardless of the installation date or location. Provide signed certification, from the manufacturer's corporate headquarters, that guarantees that the microprocessor software and access system will not terminate the unlimited and unrestricted access at any future date.

2.5.2.3 Elevator Controller Certification

For elevator installations in the United States, including United States territories, provide an elevator microprocessor controller that has a current certificate of safety code compliance issued by the Technical Standards and Safety Authority (TSSA), Toronto, Canada.

2.6 OPERATING PANELS, SIGNAL FIXTURES, AND COMMUNICATIONS CABINETS

For all panels and fixtures, provide identical and uniform panel and fixture design, material, finish, and components for all elevators. For all panels and fixtures, legibly and indelibly identify all buttons, devices, and all operating positions for each device. Use engraving and backfilling, or photo etching, for button and device designations. Do not use attached signs. Provide elevator manufacturers' standard grade for all key switches unless otherwise specified. All illuminating panels and fixture components must utilize LED lighting for energy efficiency.

2.6.1 Car and Hall Buttons

For all cab and landing fixture buttons, provide industry-standard, vandal resistant push buttons with positive-stop assembly design. Buttons must be minimum 3/4 inch diameter, satin-finish stainless steel, with illuminating LED halo.

2.6.2 Passenger Car-Operating Panel

Provide each car with one car operating panel that contains operation controls and communication devices. Provide exposed, flush mounted buttons for the controls identified in subparagraph PASSENGER CONTROLS. Provide a lockable service cabinet for the controls listed in subparagraph SERVICE CONTROLS. Use engraving and backfilling or photo etching for button and switch designations. Do not use attached signs.

2.6.2.1 Passenger Controls

In addition to ASME A17.1/CSA B44 requirements, provide the following operating controls, identified as indicated:

- a. Illuminating car-call buttons identified to correspond to landings served by the elevator.
- b. "DOOR OPEN" and "DOOR CLOSE" buttons. For front and rear openings at the same floor, include the identification "F" and "R" for each opening.
- c. Red, illuminating "ALARM" button.
- d. Key-operated "Independent Service" switch.
- e. "Help" communication device to include communication between elevator cab and elevator machine room or control room.

2.6.2.2 Service Controls

In addition to ASME A17.1/CSA B44 requirements, provide the following operating controls, identified as indicated:

- a. Provide a key-operated, three-position switch for "In car Inspection Operation" and "Hoistway Access". The center switch position will provide normal, automatic operation.
- b. "Car Light" switch.
- c. "Car Fan" switch with two speed settings identified.
- d. 120-volt ac 60 Hz single-phase duplex electrical outlet of ground-fault-circuit-interrupt (GFCI) design.

2.6.2.3 Certificate Window

Provide a minimum 4 inch wide by 6 inch high certificate window for elevator inspection certificate. Locate window in the Service Controls door of the Car Operating Panel.

2.6.2.4 Emergency Signaling Devices

Provide an audible signaling device, operable from the Car Operating Panel button marked "ALARM". The audible signaling device must have a sound pressure rating between 80 and 90 dBA at 10 ft. Provide battery backup power capable of operating the audible signaling device for at least one hour.

2.6.3 Elevator In-Car Position Indicators

For all elevators, provide illuminating position indicator in the Car Operating Panel.

2.6.4 Elevator In-Car Direction Indicators

For 2-stop elevator installations, provide visual direction indicators and audible car arrival signal in the elevator car door jamb, in accordance with ABA Standards. Visual indicators must be visible from the hall call fixture.

2.6.5 Hall Call Landing Fixtures

Provide a hall call fixture adjacent to each elevator. Provide a single push-button for terminal landings and dual push-buttons, up and down, at intermediate landings.

2.6.5.1 Designated Landing Hall Call Fixture

2.6.5.1.1 Location of COMMUNICATION MEANS FAILURE (CMF) Visual Signal

When required by ASME A17.1/CSA B44, provide an elevator CMF audible and illuminating signal, and reset switch, in the FEO Designated Landing hall call fixture. Mount the signal and reset switch at a minimum of 7 inches above the "UP" hall call button.

2.6.5.1.2 COMMUNICATION MEANS FAILURE (CMF) Visual and Audible Signal Operation

Provide a CMF visual and audible signal system that conforms to ASME A17.1/CSA B44. Provide continuous verification of operability of the telephone line and immediate activation of audible and visual signals when verification means determines that the telephone line is not functioning. Provide illumination of visual signal at one second intervals. Provide a minimum of 65 dBA audible signal at 30 second intervals.

2.6.5.1.3 Firefighters' Emergency Operation Phase I Switch and Visual Signal

When required by ASME A17.1/CSA B44, provide an elevator Firefighters' Emergency Operation Phase I switch and illuminating visual signal in the FEO Designated Landing hall call fixture. Provide FEO Phase I visual signal that is designed with intermittent, flashing, illumination when actuated by the machine room, control room, or hoistway fire alarm initiating device. Locate FEO Phase I key switch above the CMF visual signal with a minimum of 6 inches vertical between the centerlines of the CMF signal and the FEO Phase I key switch. Locate FEO Phase I visual signal directly above the Phase I switch. In addition, locate Elevator Corridor Call Station Pictograph at top of hall call fixture.

2.6.6 Emergency or Standby Power

When emergency or standby power is provided for elevator operation, provide an elevator emergency power visual indicator that conforms to ASME A17.1/CSA B44. Locate the visual signal in the Firefighters Emergency Operation fixture for each simplex elevator and for each elevator group. When an emergency power selector switch is required, provide switch in a separate, flush mounted fixture located at the

designated level, in view of all elevator entrances.

2.7 CAR DOOR EQUIPMENT

2.7.1 Car Door Operator

Provide elevator door operator equipment and circuitry that is designed and installed as discreet communication. Serial communication must not be used for this system.

2.7.2 Infra-red Curtain Unit

Provide Infra-red Curtain Unit (ICU) with multiple infra-red beams that protect to the full height and width of the door opening. Provide door nudging operation.

2.8 PASSENGER ELEVATOR GUIDES, PLATFORM, AND ENCLOSURE

2.8.1 Roller Guides

Provide coil-spring loaded roller guide assemblies in adjustable mountings on each side of car and counterweight frames in accurate alignment at top and bottom of frames.

2.8.2 Car Enclosure Wall Panels, Return Panels, Doors, Entrance Columns, and Transom

Provide 14 Gauge minimum stainless steel entrance components. Use same material and finish for all hoistway and car entrance assemblies. Apply sound-deadening material on exterior of all cab wall panels.

2.8.3 Car Enclosure Top

Provide reinforced, 12 gauge minimum steel car enclosure top. Provide hinged emergency exit with lock that complies with the seismic risk zone 2 or greater design requirements of ASME A17.1/CSA B44. Locate emergency exit hinge towards the rear of the elevator cab. Design and configure the elevator cab interior ceiling to provide convenient and unobstructed access to, and use of, emergency exit from inside the elevator cab.

2.8.4 Car Door

Provide 16 gauge minimum stainless steel car doors of sandwich construction with flush surfaces on car and landing sides. Provide a minimum of 2 door guide assemblies per door panel, one guide at leading and one at trailing door edge with guides in the sill groove their entire length of travel.

2.8.5 Car Entrance Sill

Provide one piece cast nickel silver, stainless steel, or white bronze entrance sill(s). Set sills level and flush with floor finish. Use same material for hoistway and car entrance sills.

2.8.6 Cab Finish Floor

Provide cab finish floor with top of finish floor flush with the cab sill.

2.8.7 Car Fan

Provide 2-speed fan for car enclosure forced ventilation. Fan must be mounted in the car enclosure top.

2.8.8 Car Lighting

Utilize LED lighting for elevator car interior illumination. Provide a minimum of 10 foot-candles, measured at all areas of the car enclosure floor. Provide automatic car lighting operation that will turn off car lights after 3 minutes of inactivity. Car lights must automatically turn on upon actuation of an elevator car or hall call. Provide recessed lighting.

2.8.9 Car Protection Pads and Hooks

Provide fire retardant, hanging car protection pads that provide protection for all car interior wall panels. Provide permanently installed studs in car that are designed for hanging the car protection pads in the car.

2.9 PASSENGER ELEVATOR HOISTWAY DOORS AND ENTRANCES

Provide hoistway entrance assemblies with a minimum 1-1/2 hour fire rating. Use same material and finish for all hoistway and car entrance assemblies.

2.9.1 Hoistway Entrance Frames

Provide 14 gage minimum stainless steel hoistway entrance frames. Solidly grout uprights of entrance ways to height of 5 feet.

2.9.2 Hoistway Entrance Sills

Provide one-piece cast nickel silver, stainless steel, or white bronze entrance sills. Set top of landing sill flush with top of finish floor. Solidly grout under full length of sill. Use same material for all hoistway and car entrance sills.

2.9.3 Hoistway Entrance Doors

Provide stainless steel non-vision construction hoistway entrance doors with flush surfaces on car and landing sides. Provide a minimum of 2 door guide assemblies per door panel, one guide at leading edge and one at trailing edge with guides in the sill groove the entire length of door travel. Use same material and finish for all hoistway and car entrance assemblies.

2.9.4 Hoistway Entrance Door Track Dust Covers

Provide sheet metal hoistway door track dust covers at each landing. Dust covers must cover top and hoistway side of door locks and door roller tracks, and extend the full width of the door track and associated hardware. Dust cover sections will not exceed 3 feet in length.

2.10 HOISTWAY EQUIPMENT

2.10.1 Car Guide Rails and Fastenings

Provide T-section type guide rails for car. Paint rail shanks with one coat of black enamel.

2.10.2 Pit Equipment and Support Channels

Provide rail-to-rail pit channels to serve as mounting surface for main guide rails, hydraulic cylinder and car buffers. Method of installation of channels, brackets and buffer mounts must be such that pit waterproofing is not punctured.

2.10.3 Pit "STOP" Switch

Provide a total of either two or three push-to-stop/pull-to-run type pit "STOP" switches in the elevator hoistway pit. Provide one or two switches, as required by ASME A17.1/CSA B44, at the entrance to the elevator pit. Provide an additional "STOP" switch in the elevator hoistway pit entrapment protection area. The additional push-to-stop pit stop switch must be provided within the hoistway pit entrapment protection egress area, at a height between 50 inches (1270 mm) and 60 inches (1524 mm) above the pit floor.

2.10.4 Traveling Cables

Suspend traveling cables by means of self-tightening webbed devices or internal suspension members.

2.10.5 Hoistway Pit Ladder

Provide continuous horizontal rungs for the full height of the pit ladder.

PART 3 EXECUTION

3.1 INSTALLATION

Install in accordance with DOD design criteria, contract specifications, manufacturer's instructions, NEII-1 Building Transportation Standards and Guidelines, and all applicable building and safety code requirements.

3.1.1 Structural Members and Finish Materials

Do not cut or alter structural members. Do not alter finish materials from manufacturer's original design. Restore any damaged or defaced work to original condition.

3.1.2 Miscellaneous Requirements

Provide recesses, cutouts, slots, holes, patching, grouting, and refinishing to accommodate elevator installation. Use core drilling to drill all new holes in concrete. Finish work to be straight, level, and plumb. During installation, protect machinery and equipment from dirt, water, or mechanical damage. At completion, clean all work and spot paint.

3.2 FIELD QUALITY CONTROL

The Contractor will provide and utilize a third-party licensed and

certified Qualified Elevator Inspector (QEI) to conduct elevator pre-acceptance inspection and testing. The QEI must perform inspections and witness tests to ensure that the installation conforms to all applicable safety codes and contract requirements. The QEI will be directly employed by the Contractor and independent of the elevator contractor.

Upon completion, the QEI must provide written test data for all ASME A17.1/CSA B44 Acceptance Tests and written certification that the elevator is complete and ready for final Acceptance Inspection, Testing, and Commissioning.

3.3 ACCEPTANCE INSPECTION, TESTING AND COMMISSIONING

When elevator system installation is complete and ready for final inspection, notify Contracting Officer that elevator system is ready for Acceptance Inspection, Testing, and Commissioning. Provide QEI certification specified in Article FIELD QUALITY CONTROL.

Contracting Officer will obtain services of Naval Facilities Engineering Systems Command (NAVFAC) QEI Certified Elevator Inspector. NAVFAC QEI will utilize the applicable NAVFAC Elevator Acceptance Inspection Form to record the results of inspection and testing and to identify safety code and contract deficiencies. Specific values must be provided for all tests required by ASME A17.1/CSA B44, ASME A17.2, and contract documents. Upon completion of inspection and testing, the NAVFAC QEI will sign a copy of the completed forms and provide the signed copy to the Contracting Officer or representative. Within 2 weeks of the inspection, the QEI will also prepare a formal inspection report, including all test results and deficiencies. Upon successful completion of inspection and testing, NAVFAC Certified Elevator Inspector will complete, sign and post form NAVFACENGCOM 9-11014/23(Rev.9-2009), Elevator Inspection Certificate.

3.3.1 Acceptance Inspection Support

Prime and Elevator Contractors must provide inspection support and perform all required tests, in order to demonstrate proper operation of each elevator system and to prove that each system complies with contract requirements and all applicable building and safety codes. Inspection procedures in ASME A17.2 form a part of this inspection and acceptance testing. All inspection and testing must be conducted in the presence of the Qualified Elevator Inspector (QEI).

If the elevator does not comply with all contract and safety code requirements on the initial Acceptance Inspection and Test, the Contractor is responsible for all costs involved with re-inspection and re-testing required as a result of contractor delays and discrepancies discovered during inspection and testing.

3.3.2 Testing Materials and Instruments

Furnish all testing materials and instruments necessary for Acceptance Inspection, Testing and Commissioning. At a minimum, include calibrated test weights, tachometer, accelerometer, hydraulic pressure gauge, 600-volt mega ohm meter, volt meter and ammeter, infrared temperature gauge, door pressure gage, dynamometer, and 20 foot tape measure.

3.3.3 Field Tests

3.3.3.1 Endurance Tests

Test each elevator for a period of one hour continuous, automatic operation, with specified rated load in the elevator cab. During the one hour test, stop car at each floor, in both directions of travel, and allow automatic door open and close operation. The requirements for Automatic Operation, Rated Speed, Leveling, Temperature Rise and Motor Amperes must be met throughout the duration of the Endurance Test. Restart the one hour test period from the beginning, following any shutdown or failure.

3.3.3.2 Speed Tests

Determine actual speed of each elevator, in both directions of travel, with rated load and with no load in elevator car. Make Speed tests at the beginning and at the end of the Endurance test. Determine speed by tachometer reading or accelerometer, excluding accelerating and slow-down zones. Under all conditions, minimum acceptable elevator speed is the Rated speed specified. Maximum acceptable elevator speed is 110 percent of Rated speed.

3.3.3.3 Leveling Tests

Test elevator car leveling operation and provide a leveling accuracy equal to or less than 1/8 inch at each floor with no load in car, and with rated load in car, in both directions of travel. Determine leveling accuracy at the beginning and at the end of the endurance tests.

3.3.3.4 Temperature Rise Tests

Determine temperature rise of elevator pump motor and hydraulic fluid during one-hour full-load test run. Under these conditions, maximum temperature rise must not exceed acceptable temperature rise indicated on manufacturer's data plate. Start test only when equipment is within 5 degrees C of ambient temperature.

3.3.3.5 Motor Ampere Tests

At beginning and end of Endurance test, measure and record motor amperage in both directions of travel and in both no-load and rated load conditions.

3.3.3.6 Elevator Performance and Ride Quality Testing

Evaluate elevator performance to ensure compliance with specification requirements related to the NEII-1 Performance Standards Matrix for New Elevator Installations.

3.3.3.7 Hydraulic Safety Valve (Automatic Shutoff Valve) Tests

In order to ensure consistent performance, regardless of hydraulic oil temperature, test the Hydraulic Safety Valve twice. Test once before the one-hour endurance test and once immediately after the one-hour test. For elevator certification, safety valve must perform to code in both tests.

3.3.3.8 Hydraulic Pressure Tests

Check the hydraulic static pressure and rated-speed operating pressure at the hydraulic control valve, under both no load and rated load conditions.

3.3.3.9 Pressure Test of Liner/Cylinder Assembly

Perform 20 psig pressure test of the completed and installed liner/cylinder assembly. Test liner/cylinder assembly as a sealed unit. Provide safety relief valve set to relieve at 20 psig; 4.5 inch diameter dial pressure gage scaled for 0 to 50 psig and calibrated to 0.5 percent accuracy; and an air pressure admission throttle and shutoff valve. For safety, pressure test must only be performed when liner and cylinder are fully inserted and assembled in the well casing. Perform the test from remote location outside of the elevator pit. Perform test in the presence of, and witnessed by, a Certified Elevator Inspector.

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SECTION 21 12 00

PIER STANDPIPE SYSTEMS
05/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C153/A21.53	(2019) Ductile-Iron Compact Fittings for Water Service
AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast

ASTM INTERNATIONAL (ASTM)

ASTM D256	(2010; R 2018) Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D1002	(2010; R 2019) Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
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NATIONAL ASSOCIATION OF PIPE FABRICATORS (NAPF)

NAPF 500-03	(2000; R 2006) Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special
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Internal Linings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2019; Errata 19-1; Errata 19-2; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; Errata 19-3; Errata 20-4; TIA 19-5; TIA 19-6) Standard for the Installation of Sprinkler Systems
NFPA 14	(2019; TIA 19-1) Standard for the Installation of Standpipes and Hose Systems
NFPA 24	(2019; TIA 19-1) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 307	(2021) Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves

UNDERWRITERS LABORATORIES (UL)

UL 312	(2010; Reprint Mar 2018) UL Standard for Safety Check Valves for Fire-Protection Service
UL Fire Prot Dir	(updated continuously online) Fire Protection Equipment Directory

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP10/NACE NO.2	(2007) Near-White Blast Cleaning
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U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01	(2020; with Change 5) Fire Protection Engineering for Facilities
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1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS and 40 05 13 PIPELINES, PROCESS PIPING applies to this section with additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Design and provide new manual dry standpipe system as shown on the Contract Drawings.

1.4 SYSTEM DESCRIPTION

System design and manufacturer's products must be in accordance with the required and advisory provisions of NFPA 307 and UFC 3-600-01 except as modified herein. Each system must include materials, accessories, and equipment outside the building necessary to provide each system complete and ready for use. Devices and equipment must be UL Fire Prot Dir listed or FM APP GUIDE approved for fire protection service. In the publications referred to herein, reference to the "authority having jurisdiction" must be interpreted to mean the MIDLANT Division, Naval Facilities Engineering

Systems Command, Fire Protection Engineer.

1.4.1 Pier Standpipe System Drawings

Prepare in accordance with the requirements for "Plans and Specifications" as specified in NFPA 307 and NFPA 14. Each drawing must be 34 by 22 inches. Plans must be drawn to a scale not less than 1/8 inch scale. Do not commence work until the design of each system and the various components have been approved. Show data essential for proper installation of each system. Show details, plan view, elevations, and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show:

- a. Room, space or area layout and include pipe supports and hangers.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

The fire protection engineer, MIDLANT Division, Naval Facilities Engineering Systems Command will review any approve all submittals in this section requiring Government approval.

SD-02 Shop Drawings

Pier Standpipe System; G

SD-03 Product Data

Pipe and Fittings; G

Pipe Hangers and Supports; G

Valves, including Ball; G

Expansion Joints and Seismic Joints; G

Fire Department Connections; G

Buried Pipe and fittings; G

Data which describes more than one type of item must be clearly marked to indicate which type the Contractor intends to provide. Submit one original for each item and clear, legible, first-generation photocopies for the remainder of the specified copies. Incomplete or illegible photocopies will not be accepted. Partial submittals will not be accepted.

SD-06 Test Reports

Preliminary Tests; G

Acceptance Tests; G

Submit for all inspections and tests specified under paragraph entitled "Field Quality Control."

SD-07 Certificates

Qualifications of Installer; G

Submit installers qualifications as required under paragraph entitled "Qualifications of Installer."

SD-10 Operation and Maintenance Data

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Furnish one complete package prior to the time that final acceptance tests are performed, and furnish the remaining before the contract is completed. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the location of the building, the name of the Contractor, system manufacturer and the contract number. The instructions must be legible and easily read, with large sheets of drawings folded in. The package must include: schematic drawings showing piping; circuit drawings; installation instructions; maintenance instructions; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list.

SD-11 Closeout Submittals

System As-Built Drawings; G

1.6 QUALITY ASSURANCE

1.6.1 Qualifications of Installer

Prior to commencing work, submit data showing that the Contractor has successfully installed fire extinguishing Pier standpipe systems of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having the required experience. Include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system, and certify that the system has performed satisfactorily for a period of at least 18 months.

Qualifications of System Technician: Installation drawings, shop drawing and as-built drawings must be prepared, by or under the supervision of, an individual who is experienced with the types of works specified herein.

1.6.2 System As-Built Drawings

Upon completion, and before final acceptance of the work, submit a complete set of as-built drawings of each system. Submit 34 by 22 inch reproducible as-built drawings on mylar film with title block similar to full size contract drawings. Furnish as-built(record) working drawings in addition to the as-built drawings required by Division 1, "General Requirements."

1.7 DELIVERY, STORAGE AND HANDLING

Protect stored equipment from weather, humidity and temperature

variations, dirt, dust, and other contaminants.

PART 2 PRODUCTS

2.1 PIER ABOVEGROUND AND TRENCH PIPING SYSTEMS

Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing pipe fittings; bushings will not be permitted. Perform welding in the shop or in the field. Slope piping with pitch as indicated per NFPA 14. Slope pier and underground standpipe piping to low point indicated on contract drawings for draining purposes.

2.1.1 Pipe and Fittings

Piping must be Class 53, AWWA C151/A21.51 double cement-lined ductile iron with welded flanges for sizes 4 inches and larger, schedule 40 naval brass for sizes less than 4 inches. Provide cement-mortar lined iron fittings in accordance with AWWA C104/A21.4 and conforming to AWWA C110/A21.10, AWWA C153/A21.53 and AWWA C111/A21.11. Fittings must be welded or flanged-end type. Fittings for naval brass pipe must be naval brass and welded, threaded, grooved or flanged. Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted. Fittings and rubber gaskets must be supplied by the same manufacturer.

2.1.1.1 Gaskets

Gaskets for flanged connections must be of appropriate type for the specific connection they are intended in accordance with UL 312, AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53. Other gasket types may be allowed as appropriate for the specific joint-type and must be individually evaluated.

2.1.1.2 Coatings

Coat the exterior of all standpipe piping, fittings, and valves with a three part coating system as follows:

- a. Base Coat: Prepare surface in accordance with SSPC SP10/NACE NO.2 or NAPF 500-03 in accordance with the coatings suppliers instructions. A 2-part, VOC free, 100% solids epoxy coating system suitable for immersion service. Apply for a dry film thickness of not less than 8 mils. Color white. Coating must meet the following typical properties when tested at 28 days at 72 degrees F:
 1. Tensile Shear Adhesion (mild steel substrate): 3,300 psi (ASTM D1002)
 2. Shore D Hardness: 84 (ASTM D2240)
 3. Izod Impact Strength: 0.85 ft-lbs/in. (ASTM D256)
 4. Tensile Strength at Yield: 3,200 psi (ASTM D638)
- b. Intermediate Coats: Apply same material as the base coat for a total dry film thickness of the base plus intermediate coat of not less than 16 mils. Color Grey.

- c. Top Coat: Two-component, polyurethane top coat as listed in Master Painters Institute (MPI) Approved Products Listing MPI #72. The dry film thickness of the top coat must not be less than 3 mils. Color red.

2.1.2 Pipe Hangers and Supports

Provide stainless steel pipe hangers and supports in accordance with NFPA 13 or as indicated on the plumbing drawings. Isolation valves must be butterfly valves or as indicated on the drawings.

2.1.3 Valves

Provide valves of types approved for fire service. Hose and gate valves must open by counterclockwise rotation.

2.1.3.1 Hose Valves

Provide bronze Hose Valves of types approved for fire service with 2 1/2 inch National Standard male hose threads with cap and chain.

2.1.4 Main Drains

Provide 1-inch diameter direct tap drains every 100 feet starting at the low point indicated on the contract drawings with threaded plug.

2.1.5 Pipe Sleeves

Provide where piping passes entirely through walls. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of wall. Provide one inch minimum clearance between exterior of piping and interior of sleeve or core-drilled hole. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal.

2.1.5.1 Sleeves in Masonry and Concrete Walls

Provide stainless steel sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.1.6 Expansion Joints and Seismic Joints

Refer to Section 40 05 13 PIPELINES, PROCESS PIPING.

2.1.7 Fire Department Connections

Fire department connection must be freestanding type with cast-brass body, matching escutcheon lettered "Auto Spkr" with a polished-brass finish. The connection must have individual self-closing clappers, caps with drip drains and chains. The single inlet must have a 5 inch diameter STORZ fire hose connection with cap and chain.

2.2 BURIED PIPING SYSTEMS

2.2.1 Buried Pipe and Fittings

In accordance with NFPA 24, outside coated, cement lined, ductile iron

pipe and fittings for underground piping. Anchor the joints in accordance with NFPA 24 using pipe clamps and steel rods. Minimum pipe size must be 6 inches. Minimum depth of cover must be in accordance with the Civil drawings and specifications.

2.2.2 Buried Utility Warning and Identification Tape

Provide detectable tape in accordance with Section 31 23 00.00 20
EXCAVATION AND FILL.

PART 3 EXECUTION

3.1 EXCAVATION, BACKFILLING, AND COMPACTING

Provide under this section as specified in Section 31 23 00.00 20
EXCAVATION AND FILL.

3.2 STANDPIPE SYSTEM INSTALLATION

Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing must be in accordance with the NFPA standards referenced herein. Install piping straight and true to bear evenly on hangers and supports. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard reducing pipe fittings; do not use bushings. Cut pipe accurately and work into place without springing or forcing. Ream pipe ends and free pipe and fittings from burrs. Clean with solvent to remove all varnish and cutting oil prior to assemble. Make screw joints with PTFE tape applied to male thread only.

3.3 INSTALLATION OF THE FIRE DEPARTMENT CONNECTION

Connection must be a remote FDC at the location provided on the design drawings, installed approximately 3 feet above finished grade. At the FDC, provide both a "PIER STANDPIPE FIRE DEPARTMENT CONNECTION" identification sign and a sign stating "PRESSURE NOT TO EXCEED 150 PSI" to be installed at the FDC location on galvanized u-channel post.

3.4 FIELD PAINTING

Field painting of fire extinguishing standpipe system must be specified in Section 09 90 00 PAINTS AND COATINGS. Field painting requirements for "Fire Extinguishing Sprinkler Systems" must apply.

3.5 FIELD QUALITY CONTROL

Prior to initial operation, inspect equipment and piping systems for compliance with drawings, specifications, and manufacturer's submittals. Perform tests in the presence of the Contracting Officer to determine conformance with the specified requirements.

3.5.1 Preliminary Tests

Each piping system must be hydrostatically tested at 200 psig or 50 psi in excess of the system working pressure, whichever is greater, in accordance with NFPA 14 and NFPA 24 and must show no leakage or reduction in gauge pressure after 2 hours. The Contractor must conduct complete preliminary tests, which must encompass all aspects of system operation. When tests have been completed and all necessary corrections made, submit to the

Contracting Officer a signed and dated certificate, similar to that specified in NFPA 13, attesting to the satisfactory completion of all testing and stating that the system is in operating condition and the contractor must complete drain the system. Also include a written request for a formal inspection and test.

3.5.2 Formal Inspection and Tests (Acceptance Tests)

The MIDLANT Division, Naval Facilities Engineering Systems Command, Fire Protection Engineer, will witness formal tests and approve all systems before they are accepted. The system must be considered ready for such testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the Contracting Officer and written certification to this effect is received by the Division Fire Protection Engineer. Submit the request for formal inspection at least 15 working days prior to the date the inspection is to take place. Experienced technicians regularly employed by the Contractor in the installation of both the mechanical and electrical portions of such systems must be present during the inspection and must conduct the testing. All instruments, personnel, appliances and equipment for testing must be furnished by the Contractor. The Government will furnish water for the tests. All necessary tests encompassing all aspects of system operation must be made including the following, and any deficiency found must be corrected and the system retested at no cost to the Government.

3.5.3 Additional Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system must be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, the Contracting Officer must be notified when the additional work has been completed, to arrange a new inspection and test of the system. All tests required must be repeated prior to final acceptance, unless directed otherwise.

-- End of Section --

SECTION 21 13 13

WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.21	(2016) Nonmetallic Flat Gaskets for Pipe Flanges

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1013	(2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)
ASSE 1015	(2011) Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies - (ANSI approved 2010)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA M14	(2015) Manual: Recommended Practice for

Backflow Prevention and Cross-Connection
Control

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A135/A135M	(2009; R2014) Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-71	(2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2019; Errata 19-1; Errata 19-2; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; Errata 19-3; Errata 20-4; TIA 19-5; TIA 19-6) Standard for the Installation of Sprinkler Systems
NFPA 24	(2019; TIA 19-1) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 291	(2019) Recommended Practice for Fire Flow Testing and Marking of Hydrants

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES
(NICET)

NICET 1014-7	(2012) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout
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UNDERWRITERS LABORATORIES (UL)

UL 199	(2020) UL Standard for Safety Automatic Sprinklers for Fire-Protection Service
UL 262	(2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service
UL 312	(2010; Reprint Mar 2018) UL Standard for Safety Check Valves for Fire-Protection Service
UL 405	(2013; Bul. 2020) UL Standard for Safety Fire Department Connection Devices
UL 668	(2004; Reprint Jul 2016) UL Standard for Safety Hose Valves for Fire-Protection Service
UL 789	(2004; Reprint May 2017) UL Standard for Safety Indicator Posts for Fire-Protection Service
UL Fire Prot Dir	(updated continuously online) Fire Protection Equipment Directory

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01	(2020; with Change 5) Fire Protection Engineering for Facilities
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1.2 SYSTEM DESCRIPTION

Provide wet pipe sprinkler system(s) in areas indicated on the drawings. Except as modified herein, the system must meet the requirements of UFC 3-600-01, and NFPA 13. Pipe sizes which are not indicated on the Contract drawings must be determined by hydraulic calculations.

1.2.1 Hydraulic Design

1.2.1.1 Basis for Calculations

A waterflow test was performed on December 8th, 2020 at hydrants 3-67 and 3-68 along Burmand Road closest to the proposed site location and resulted in a static pressure of 95 psi with a residual pressure of 78 psi while flowing 1,275 gpm. Perform a fire hydrant flow test no more than 6 months prior to submission of the hydraulic calculations in accordance with NFPA 291 and UFC 3-600-01. Results must include hydrant elevations relative to the building and hydrant number/identifiers for the tested hydrants, including which were flowed, which had a gauge. This information must be presented in a tabular form if multiple hydrants were flowed. The results must be included with the hydraulic calculations. Hydraulic calculations must be based on flow test performed no more than 6 months prior to the submission of the hydraulic calculations, unless verified by the NAVFAC MIDLANT Fire Protection Engineer and approved by Contracting Officer. Hydraulic calculations must be based upon the Hazen-Williams formula with a "C" value noted in NFPA 13 for piping. Hydraulic calculations must be based on operation of the fire pump(s)

provided in Section 21 30 00 FIRE PUMPS. The minimum residual pressure in a service lateral (lead-in) at the 150% of the fire pump rated flow must be 20 psi at the inlet to the backflow preventer.

1.2.1.2 Hydraulic Calculations

- a. Water supply curves and system requirements must be plotted on semi-logarithmic graph ($N^{1.85}$) paper so as to present a summary of the complete hydraulic calculation.
- b. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, minimum discharge pressures and minimum flows. Elevations of hydraulic reference points (nodes) must be indicated.
- c. Documentation must identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe.
- d. Where the sprinkler system is supplied by interconnected risers, the sprinkler system must be hydraulically calculated using the hydraulically most demanding single riser. The calculations must not assume the simultaneous use of more than one riser.
- e. All calculations must include the backflow preventer manufacturer's stated friction loss at the design flow or 8 psi for double check backflow preventer, whichever is greater.
- f. All calculations must be performed back to the actual location of the flow test, taking into account the direction of flow in the service main at the test location.
- g. For gridded systems, calculations must show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. A flow diagram indicating the quantity and direction of flows must be included.

1.2.1.3 Design Criteria

Hydraulically design the system to discharge a minimum density as indicated on the drawings. Hydraulic calculations must be in accordance with the Area/Density Method of NFPA 13. Add an allowance for exterior hose streams and domestic demand as indicated on the drawings to the sprinkler system demand at the point of connection to the existing water system.

1.2.2 Sprinkler Coverage

Sprinklers must be uniformly spaced on branch lines. Provide coverage throughout 100 percent of the area noted on the Contract drawings. This includes, but is not limited to, telephone rooms, electrical equipment rooms (regardless of the fire resistance rating of the enclosure), boiler rooms, switchgear rooms, transformer rooms, attached electrical vaults and other electrical and mechanical spaces. Coverage per sprinkler must be in accordance with NFPA 13 and UFC 3-600-01. Provide sprinklers below all obstructions in accordance with NFPA 13.

1.2.3 Qualified Fire Protection Engineer (QFPE)

An individual who is a licensed professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) and has relevant fire protection engineering experience. Services of the QFPE must include:

- a. Reviewing SD-02, SD-03, and SD-05 submittal packages for completeness and compliance with the provisions of this specification. The QFPE must review the shop drawings, calculations, and material data sheets, and must bear the review stamp of the QFPE indicating approval prior to submitting the shop drawings to the DFPE.
- b. Provide a letter documenting that the SD-02, SD-03, and SD-05 submittal package has been reviewed and noting all outstanding comments.
- c. Performing in-progress construction surveillance prior to installation of ceilings (rough-in inspection).
- d. Witnessing pre-Government and final Government functional performance testing and performing a final installation review where required by the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Partial submittals and submittals not fully complying with NFPA 13 and this specification section must be returned disapproved without review. SD-02, SD-03 and SD-05 must be submitted simultaneously.

Shop drawings (SD-02), product data (SD-03) and calculations (SD-05) must be prepared and signed by the Sprinkler System Designer and combined and submitted as one complete package. The QFPE must review the SD-02/SD-03/SD-05 submittal package for completeness and compliance with the Contract provisions prior to submission to the Government. The QFPE must provide a Letter of Confirmation that they have reviewed the submittal package for compliance with the contract provisions. This letter must include their professional engineer stamp and signature. Partial submittals and submittals not reviewed by the QFPE must be returned disapproved without review.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualified Fire Protection Engineer (QFPE); G

Sprinkler System Designer; G

Sprinkler System Installer; G

SD-02 Shop Drawings

Shop Drawing; G

SD-03 Product Data

Pipe; G

Fittings; G

Valves, including gate, check, butterfly, and globe; G

Relief Valves; G

Sprinklers; G

Pipe Hangers and Supports; G

Sprinkler Alarm Switch; G

Valve Supervisory (Tamper) Switch; G

Fire Department Connection; G

Backflow Prevention Assembly; G

Air Vent; G

Hose Valve; G

Nameplates; G

SD-05 Design Data

Hydraulic Calculations; G

SD-06 Test Reports

Test Procedures; G

SD-07 Certificates

Verification of Compliant Installation; G

Request for Government Final Test; G

SD-10 Operation and Maintenance Data

Operating and Maintenance (O&M) Instructions; G

Spare Parts Data; G

SD-11 Closeout Submittals

As-built drawings; G

1.4 QUALITY ASSURANCE

1.4.1 Preconstruction Submittals

Within 36 days of contract award but no less than 14 days prior to

commencing work on site, the prime Contractor must submit the following for review and approval. SD-02, SD-03 and SD-05 submittals received prior to the review and approval of the qualifications will be returned Disapproved Without Review.

1.4.1.1 Shop Drawing

Three copies of the shop drawings, no later than 28 days prior to the start of system installation. Working drawings conforming to the requirements prescribed in NFPA 13 and must be no smaller than ANSI D. Each set of drawings must include the following:

- a. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
- b. Floor plans drawn to a scale not less than 1/8-inch equals 1-foot clearly showing locations of devices, equipment, risers, and other details required to clearly describe the proposed arrangement.
- c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross mains and branch lines to finished floor and roof or ceiling. A detail must show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.
- d. Longitudinal and transverse building sections showing typical branch line and cross main pipe routing, elevation of each typical sprinkler above finished floor and elevation of "cloud" or false ceilings in relation to the building ceilings.
- e. Plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance.
- f. Riser layout drawings drawn to a scale of not less than 1/2-inch equals 1-foot to show details of each system component, clearances between each other and from other equipment and construction in the room.
- g. Details of each type of riser assembly, pipe hanger, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring. The dimension from the edge of vertical piping to the nearest adjacent wall(s) must be indicated on the drawings when vertical piping is located in stairs or other portions of the means of egress.
- h. Details of each type of pipe hanger and related components.
- i. Include fire pump curve with shop drawings and hydraulic calculations.

1.4.1.2 Product Data

Three copies of annotated catalog data to show the specific model, type, and size of each item. Catalog cuts must also indicate the NRTL listing. The data must be highlighted to show model, size, options, and other pertinent information, that are intended for consideration. Data must be adequate to demonstrate compliance with all contract requirements. Product data for all equipment must be combined into a single submittal.

1.4.1.3 Hydraulic Calculations

Calculations must be as outlined in NFPA 13 except that calculations must be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Calculations must include isometric diagram indicating hydraulic nodes and pipe segments. Include fire pump curve with submittal.

1.4.1.4 Operating and Maintenance (O&M) Instructions

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA as supplemented and modified by this specification section.

Provide six manuals and one pdf version on electronic media. The manuals must include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted must be capable of providing 4-hour on-site response to a service call on an emergency basis.

Submit spare parts data for each different item of material and equipment specified. The data must include a complete list of parts and supplies, and a list of parts recommended by the manufacturer to be replaced after 1-year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

1.4.2 Qualifications

1.4.2.1 Sprinkler System Designer

The sprinkler system designer must be certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Water-Based Systems Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7.

Working (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of, the Sprinkler System Designer and must be signed by the Sprinkler System Designer. Services of the Sprinkler System Designer must also include:

- a. Performing in-progress construction surveillance prior to installation of ceilings (rough-in inspection).
- b. Signing applicable certificates under SD-07.

1.4.2.2 Sprinkler System Installer

The sprinkler system installer must be regularly engaged in the installation of the type and complexity of system specified in the contract documents, and must have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.3 Regulatory Requirements

Equipment and material must be listed or approved. Listed or approved, as used in this Section, means listed, labeled or approved by a Nationally

Recognized Testing Laboratory (NRTL) such as UL Fire Prot Dir or FM APP GUIDE. The omission of these terms under the description of an item or equipment described must not be construed as waiving this requirement. All listings or approvals by testing laboratories must be from an existing ANSI or UL published standard. The recommended practices stated in the manufacturer's literature or documentation are mandatory requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. All pipes must be either capped or plugged until installed.

1.6 EXTRA MATERIALS

Spare sprinklers and wrench(es) must be provided as spare parts in accordance with NFPA 13.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Provide materials, equipment, and devices listed for fire protection service when so required by NFPA 13 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for a classification of material. Material and equipment must be standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid.

2.1.2 Nameplates

Major components of equipment must have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new name plate permanently affixed to the item or equipment. Nameplates must be etched metal or plastic, permanently attached by screws to control units, panels or adjacent walls.

2.1.3 Identification and Marking

Pipe and fitting markings must include name or identifying symbol of manufacturer and nominal size. Pipe must be marked with ASTM designation. Valves and equipment markings must have name or identifying symbol of manufacturer, specific model number, nominal size, name of device, arrow indicating direction of flow, and position of installation (horizontal or vertical), except if valve can be installed in either position. Markings must be included on the body casting or on an etched or stamped metal nameplate permanently on the valve or cover plate.

2.1.4 Pressure Ratings

Valves, fittings, couplings, alarm switches, and similar devices must be rated for the maximum working pressures that can be experienced in the system, but in no case less than 175 psi.

2.2 UNDERGROUND PIPING COMPONENTS

2.2.1 Pipe

Pipe must comply with NFPA 24. Minimum pipe size is 6 inches. Piping more than 5 feet outside the building walls must comply with Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING. A continuous section of welded stainless steel fire water service piping (In-Building Riser) from a point outside the building perimeter to a flanged fitting at least 1-foot above the finished floor within the building is acceptable.

2.2.2 Fittings and Gaskets

Fittings must be ductile-iron conforming to AWWA C110/A21.10 with cement mortar lining conforming to AWWA C104/A21.4. Gaskets must be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile-iron pipe joints must conform to AWWA C111/A21.11.

2.2.3 Gate Valve and Indicator Posts

Installation must comply with NFPA 24. Gate valves for use with indicator post must conform to UL 262. Indicator posts must conform to UL 789. Provide each indicator post with one coat of primer and two coats of red enamel paint. When provided, indicator valves must be supervised using a lock or tamper seal.

2.2.4 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape must be detectable by an electronic detection instrument. Provide tape, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold block letters continuously and repeatedly over the entire tape length. Warning and identification must read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.3 ABOVEGROUND PIPING COMPONENTS

2.3.1 Steel Piping Components

2.3.1.1 Steel Pipe

Except as modified herein, steel pipe must be black as permitted by NFPA 13 and conform to the applicable provisions of ASTM A53/A53M, ASTM A135/A135M or ASTM A153/A153M.

Steel pipe must be minimum Schedule 40 for sizes 2 inches and less; and minimum Schedule 10 for sizes larger than 2 inches. Steel piping with wall thickness less than Schedule 40 must not be threaded.

2.3.1.2 Fittings

Fittings must be welded, threaded, or grooved-end type. Threaded fittings must be cast-iron conforming to ASME B16.4, malleable-iron conforming to ASME B16.3 or ductile-iron conforming to ASTM A536. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe, steel press fittings and field welded fittings are not

permitted. Fittings, mechanical couplings, and rubber gaskets must be supplied by the same manufacturer. Threaded fittings must use Teflon tape or manufacturer's approved joint compound. Reducing couplings are not permitted except as allowed by NFPA 13.

2.3.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings must be designed for not less than 175 psi service and the product of the same manufacturer. Field welded fittings must not be used. Fitting and coupling housing must be malleable-iron conforming to ASTM A47/A47M, Grade 32510; ductile-iron conforming to ASTM A536, Grade 65-45-12. Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 2 inches and larger. Gasket must be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts must be heat-treated steel conforming to ASTM A183 and must be cadmium-plated or zinc-electroplated.

2.3.1.4 Flanges

Flanges must conform to NFPA 13 and ASME B16.1. Gaskets must be non-asbestos compressed material in accordance with ASME B16.21, 1/16-inch thick, and full face or self-centering flat ring type.

2.3.2 Flexible Sprinkler Hose

Flexible (braided) sprinkler hose will be permitted in areas with drop ceilings when secured per manufacturer's instructions.

2.3.3 Pipe Hangers and Supports

Provide galvanized pipe hangers, supports in accordance with NFPA 13.

2.3.4 Valves

Provide valves of types approved for fire service. Valves must open by counterclockwise rotation.

2.3.4.1 Control Valve

Manually operated sprinkler control/gate valve must be outside stem and yoke (OS&Y) type or butterfly type as indicated on the drawings and must be listed.

2.3.4.2 Check Valves

Check valves must comply with UL 312. Check valves 4 inches and larger must be of the swing type, have a clear waterway and meet the requirements of MSS SP-71, for Type 3 or 4. Inspection plate must be provided on valves larger than 6 inches.

2.3.4.3 Hose Valve

Valve must comply with UL 668.

2.3.5 Riser Check Valves

Provide riser check valve, pressure gauges and main drain.

2.4 ALARM INITIATING AND SUPERVISORY DEVICES

2.4.1 Sprinkler Alarm Switch

Vane or pressure-type flow switch(es). Connection of switch must be by the fire alarm installer. Vane type alarm actuating devices must have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and must instantly recycle. Flow switches for elevator power shunt must not have a retard feature.

2.4.2 Valve Supervisory (Tamper) Switch

Switch must be integral to the control valve or suitable for mounting to the type of control valve to be supervised open. The switch must be tamper resistant and contain SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.5 BACKFLOW PREVENTION ASSEMBLY

Double-check valve assembly backflow preventer complying with ASSE 1013, ASSE 1015 and AWWA M14. Each check valve must have a drain. Backflow prevention assemblies must have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR List" and be listed for fire protection use. Listing of the specific make, model, design, and size in the FCCCHR List is acceptable as the required documentation.

2.5.1 Backflow Preventer Test Connection

Test connection must consist of a series of listed angle or globe hose valves with 2 1/2-inch National Standard male hose threads with cap and chain.

2.6 FIRE DEPARTMENT CONNECTION

Fire department connection must be freestanding type with cast-brass body, matching escutcheon lettered "Auto Spkr" with a polished-brass finish. The connection must have individual self-closing clappers, caps with drip drains and chains. The single inlet must have 5 inch diameter STORZ fire hose connection with cap and chain and extend through the security fence to be accessed by the fire department on the non-secure side as shown on the design drawings.. Comply with UL 405.

2.7 SPRINKLERS

Sprinklers must comply with UL 199 and NFPA 13. Sprinklers with internal O-rings are not acceptable. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters must have temperature classification in accordance with NFPA 13.

2.7.1 Pendent Sprinkler

Pendent sprinkler must be recessed type with nominal K-factor in accordance with the Contract Drawings. Pendent sprinklers must have a finish in accordance with the Contract Drawings. Assembly must include an integral escutcheon.

2.7.2 Upright Sprinkler

Upright sprinkler must be provided with finish in accordance with the Contract Drawings and have a nominal K-factor in accordance with the Contract Drawings.

2.7.3 Sidewall Sprinkler

Sidewall sprinkler must be the recessed type. Sidewall sprinkler must have a nominal K-factor in accordance with the Contract Drawings. Sidewall sprinkler must have a finish in accordance with the Contract Drawings.

2.7.4 Concealed Sprinkler

Concealed sprinkler must have a nominal K-factor in accordance with the Contract Drawings. Coverplate must be provided with finish to match ceiling or wall finish to which it is installed.

2.7.5 Dry Sprinkler Assembly

Dry sprinkler assembly must be of the sidewall type as indicated. Assembly must include an integral escutcheon. Maximum length must not exceed maximum indicated in its listing. Sprinkler must have a finish in accordance with the Contract Drawings.

2.8 ACCESSORIES

2.8.1 Sprinkler Cabinet

Provide spare sprinklers in accordance with NFPA 13 and must be placed in a suitable metal or plastic cabinet of sufficient size to accommodate all the spare sprinklers and wrenches in designated locations. Spare sprinklers must be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed as required by NFPA 13. At least one wrench of each type required must be provided.

2.8.2 Pendent Sprinkler Escutcheon

Escutcheon must be one-piece metallic type with a depth of less than 3/4-inch and suitable for installation on pendent sprinklers. The escutcheon must have a factory finish that matches the pendent sprinkler.

2.8.3 Pipe Escutcheon

Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

2.8.4 Sprinkler Guard

Listed guard must be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards must be provided on sprinklers located in elevator machine rooms and as indicated on the contract drawings.

2.8.5 Relief Valve

Relief valves must be listed and installed at the riser in accordance with NFPA 13.

2.8.6 Air Vent

Air vents must be of the automatic type and piped to drain to the building exterior.

2.8.7 Identification Sign

Valve identification sign must be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gage steel or 0.024-inch aluminum with red letters on a white background or white letters on red background. Wording of sign must include, but not be limited to "main drain", "auxiliary drain", "inspector's test", "alarm test", "alarm line", and similar wording as required to identify operational components. Where there is more than one sprinkler system, signage must include specific details as to the respective system.

PART 3 EXECUTION

3.1 VERIFYING ACTUAL FIELD CONDITIONS

Before commencing work, examine all adjoining work on which the contractor's work that is dependent for perfect workmanship according to the intent of this specification section, and report to the Contracting Officer's Representative a condition that prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.

3.2 INSTALLATION

The installation must be in accordance with the applicable provisions of UFC 3-600-01, NFPA 13, NFPA 24 and publications referenced therein. Locate sprinklers in a consistent pattern with ceiling grid, lights, and air supply diffusers. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

- a. Piping offsets, fittings, and other accessories required must be furnished to provide a complete installation and to eliminate interference with other construction.
- b. Wherever the contractor's work interconnects with work of other trades the Contractor must coordinate with other Contractors to insure all Contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access (dampers and similar equipment) that are concealed above hung ceilings by permanent color coded pins/tabs in the ceiling directly below the item.
- c. Provide required supports and hangers for piping, conduit, and equipment so that loading will not exceed allowable loadings of structure. Submittal of a bid must be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing

required supports.

3.2.1 Waste Removal

At the conclusion of each day's work, clean up and stockpile on site all waste, debris, and trash which may have accumulated during the day as a result of work by the contractor and of his presence on the job. Sidewalks and streets adjoining the property must be kept broom clean and free of waste, debris, trash and obstructions caused by work of the contractor, which will affect the condition and safety of streets, walks, utilities, and property.

3.3 UNDERGROUND PIPING INSTALLATION

The fire protection water main must be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover must be in accordance with the Civil drawings and specification. The supply line must terminate inside the building with a flanged piece, the bottom of which must be set not less than 1-foot above the finished floor. A blind flange must be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block must be provided at the elbow where the pipe turns up toward the floor unless a stainless steel one-piece in-building riser is provided. In addition, joints must be anchored in accordance with NFPA 24. Buried steel components must be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls must meet the requirements of Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

3.4 ABOVEGROUND PIPING INSTALLATION

The methods of fabrication and installation of the aboveground piping must fully comply with the requirements and recommended practices of NFPA 13 and this specification section.

3.4.1 Piping in Exposed Areas

Install exposed piping without diminishing exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, must be installed to provide maximum headroom.

3.4.2 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping must be concealed above ceilings. Piping must be inspected, hydrostatically tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas must be concealed.

3.4.3 Pendent Sprinklers

- a. Drop nipples to pendent sprinklers must consist of minimum 1-inch pipe with a reducing coupling into which the sprinkler must be threaded.
- b. Where sprinklers are installed below suspended or dropped ceilings, drop nipples must be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling must not extend below the underside of the ceiling.

- c. Recessed pendent sprinklers must be installed such that the distance from the sprinkler deflector to the underside of the ceiling must not exceed the manufacturer's listed range and must be of uniform depth throughout the finished area.
- d. Pendent sprinklers in suspended ceilings must be located in the center of the tile (+/- 2 inches).
- e. Dry pendent sprinkler assemblies must be such that sprinkler ceiling plates or escutcheons are of the uniform depth throughout the finished space.
- f. Dry pendent sprinklers must be of the required length to permit the sprinkler to be threaded directly into a branch line tee.
- g. Where the maximum static or flowing pressure, whichever is greater at the sprinkler, applied other than through the fire department connection, exceeds 100 psi and a branch line above the ceiling supplies sprinklers in a pendent position below the ceiling, the cumulative horizontal length of an unsupported armover to a sprinkler or sprinkler drop must not exceed 12 inches for steel pipe.

3.4.4 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers must contain no fittings between the branch line tee and the reducing coupling at the sprinkler.

3.4.5 Pipe Joints

Pipe joints must conform to NFPA 13, except as modified herein. Not more than four threads must show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints must be provided where indicated or required by NFPA 13. Grooved pipe and fittings must be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools must be products of the same manufacturer. For copper tubing, pipe and groove dimensions must comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field must be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe must be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances.

3.4.6 Reducers

Reductions in pipe sizes must be made with one-piece tapered reducing fittings. When standard fittings of the required size are not manufactured, single bushings of the face or hex type will be permitted. Where used, face bushings must be installed with the outer face flush with the face of the fitting opening being reduced. Bushings cannot be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2-inch.

3.4.7 Pipe Penetrations

- a. Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors must be core-drilled and provided with pipe sleeves. Each sleeve must be Schedule 40 galvanized steel, ductile-iron or cast-iron pipe and extend through its respective wall or floor and be cut flush with each wall surface. Sleeves must provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe must be firmly packed with mineral wool insulation.
- b. Where pipes and sleeves penetrate fire barriers, fire walls, or fire partitions, pipes/sleeves must be firestopped in accordance with Section 07 84 00 FIRESTOPPING.
- c. In penetrations that are not fire-rated, the space between the sleeve and the pipe must be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.4.8 Escutcheons

Escutcheons must be provided for pipe penetration in finished areas of ceilings, floors and walls. Escutcheons must be securely fastened to the pipe at surfaces through which piping passes.

3.4.9 Inspector's Test Connection

Unless otherwise indicated, the test connection must consist of 1-inch pipe connected at the riser as a combination test and drain valve; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test". All test connection piping must be inside of the building and penetrate the exterior wall at the location of the discharge orifice only. The discharge orifice must be located outside the building wall no more than 2 feet above finished grade, directed so as not to cause damage to adjacent construction or landscaping during full flow discharge, or to the sanitary sewer. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building. Do not discharge to the roof. Discharge to floor drains, janitor sinks or similar fixtures is not permitted.

Provide concrete splash blocks at all drain and inspector's test connection discharge locations if not discharging to a concrete surface. Splash blocks must be large enough to mitigate erosion and not become dislodged during a full flow of the drain. Ensure all discharged water drains away from the facility and does not cause property damage.

3.4.10 Backflow Preventer

Locate within the building fire pump room as indicated on the fire suppression drawings.

Install backflow preventers so that the bottom of the assembly is a minimum of 6 inches above the finished floor/grade. Install horizontal backflow preventers so that the bottom of the assembly is no greater than

24 inches above the finished floor/grade. Install vertical backflow preventers so that the upper operating handwheel is no more than 6 feet above the finished floor/grade. Clearance around control valve handles must be minimum 6 inches above grade/finished floor and away from walls.

3.4.10.1 Test Connection

Provide downstream of the backflow prevention assembly UL 668 hose valves with 2.5-inch National Standard male hose threads with cap and chain. Provide one valve for each 250 gpm of sprinkler system demand or fraction thereof. Provide a permanent sign in accordance with paragraph entitled "Identification Signs" which reads, "Test Valve". Indicate location of test header. If an exterior connection, provide a control valve inside a heated mechanical room to prevent freezing.

3.4.11 Drains

- a. Main drain piping must be provided to discharge at a safe point outside the building, no more than 2 feet above finished grade. Provide a concrete splash block at drain outlet. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building.
- b. Auxiliary drains must be provided as required by NFPA 13. Auxiliary drains are permitted to discharge to a floor drain if the drain is sized to accommodate full flow (min 40 gpm). Discharge to service sinks or similar plumbing fixtures is not permitted.

3.4.12 Installation of Fire Department Connection

Connection must be mounted be a remote FDC at the location provided on the design drawings, installed approximately 3 feet above finished grade. STORZ connection must be installed through the fence such that it can be accessed on the non-secure side per the design drawings. The piping between the connection and the check valve must be provided with an automatic drip in accordance with NFPA 13 and piped to drain to the outside or a floor drain within the same room.

3.4.13 Identification Signs

Signs must be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Main drain test results must be etched into main drain identification sign. Hydraulic design data must be etched into the nameplates and permanently affixed to each sprinkler riser as specified in NFPA 13. Provide labeling on the surfaces of all feed and cross mains to show the pipe function (e.g., "Sprinkler System", "Fire Department Connection", "Standpipe") and normal valve position (e.g. "Normally Open", "Normally Closed"). For pipe sizes 4-inch and larger provide white painted stenciled letters and arrows, a minimum of 2 inches in height and visible from at least two sides when viewed from the floor. For pipe sizes less than 4-inch, provide white painted stenciled letters and arrows, a minimum of 0.75-inch in height and visible from the floor. Provide properly lettered and approved metal sign to elevator flow switch stating the circuits' voltage, and identify the switch as an "Elevator Power Shunt Flow Switch". At the remote FDC, provide both a "FIRE DEPARTMENT CONNECTION" identification sign and a sign stating "PRESSURE NOT TO EXCEED 150 PSI" to be on the non-secure exterior of the security

fence.

3.5 ELECTRICAL

Except as modified herein, electric equipment and wiring must be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Alarm signal wiring connected to the building fire alarm control system must be by the fire alarm installer.

3.6 PAINTING

Color code mark piping as specified in Section 09 90 00 PAINTS AND COATINGS.

3.7 FIELD QUALITY CONTROL

3.7.1 Test Procedures

Submit detailed test procedures, prepared and signed by the NICET Level III Fire Sprinkler Technician, and the representative of the installing company, and reviewed by the QFPE 60 days prior to performing system tests. Detailed test procedures must list all components of the installed system. Test procedures must include sequence of testing, time estimate for each test, and sample test data forms. The test data forms must be in a check-off format (pass/fail with space to add applicable test data; similar to the forms in NFPA 13). The test procedures and accompanying test data forms must be used for the pre-Government testing and the Government final testing.

- a. Provide space to identify the date and time of each test. Provide space to identify the names and signatures of the individuals conducting and witnessing each test.

3.7.2 Pre-Government Testing

3.7.2.1 Verification of Compliant Installation

Conduct inspections and tests to ensure that equipment is functioning properly. Tests must meet the requirements of paragraph entitled "Minimum System Tests" and "System Acceptance" as noted in NFPA 13. The Contractor and QFPE must be in attendance at the pre-Government testing to make necessary adjustments. After inspection and testing is complete, provide a signed Verification of Compliant Installation letter by the QFPE that the installation is complete, compliant with the specification and fully operable. The letter must include the names and titles of the witnesses to the pre-Government tests. Provide all completion documentation as required by NFPA 13 and the test reports noted below.

- a. NFPA 13 Aboveground Material and Test Certificate
- b. NFPA 13 Underground Material and Test Certificate

3.7.2.2 Request for Government Final Test

When the verification of compliant installation has been completed, submit a formal request for Government final test to the Designated Fire Protection Engineer (DFPE). Government final testing will not be scheduled until the DFPE has received copies of the request for Government final testing and Verification of Compliant Installation letter with all required reports. Government final testing will not be performed until

after the connections to the building fire alarm system have been completed and tested to confirm communications are fully functional. Submit request for test at least 15 calendar days prior to the requested test date.

3.7.3 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests must be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.7.4 Government Final Tests

The tests must be performed in accordance with the approved test procedures in the presence of the DFPE. Furnish instruments and personnel required for the tests. The following must be provided at the job site for Government Final Testing:

- a. The manufacturer's technical representative.
- b. The contractor's Qualified Fire Protection Engineer (QFPE).
- c. Marked-up red line drawings of the system as actually installed.

Government Final Tests will be witnessed by the Designated Fire Protection Engineer and Qualified Fire Protection Engineer (QFPE). At this time, all required tests noted in the paragraph "Minimum System Tests" must be repeated at their discretion.

3.8 MINIMUM SYSTEM TESTS

The system, including the underground water mains, and the aboveground piping and system components, must be tested to ensure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure must be tested in accordance with NFPA 13 and NFPA 24.

3.8.1 Underground Piping

3.8.1.1 Flushing

Underground piping must be flushed at a minimum of 10 fps in accordance with NFPA 24.

3.8.1.2 Hydrostatic Test

New underground piping must be hydrostatically tested in accordance with NFPA 24.

3.8.2 Aboveground Piping

3.8.2.1 Hydrostatic Test

Aboveground piping must be hydrostatically tested in accordance with NFPA 13. There must be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure must be read from a gauge located at the low elevation point of the system or portion being tested.

3.8.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly must be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor must provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5-inch diameter hoses, playpipe nozzles or flow diffusers, calibrated pressure gauges, and pitot tube gauge. The Contractor must provide all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction loss) across the assembly must be recorded. A metal placard must be provided on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate determined during the preliminary testing. The pressure drop must be compared to the manufacturer's data and the readings observed during the final inspections and tests.

3.8.3 Main Drain Flow Test

Following flushing of the underground piping, a main drain test must be made to verify the adequacy of the water supply. Static and residual pressures must be recorded on the certificate specified in paragraph SUBMITTALS.

3.9 SYSTEM ACCEPTANCE

Following acceptance of the system, as-built drawings and O&M manuals must be delivered to the Contracting Officer for review and acceptance. Submit six sets of detailed as-built drawings. The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings must be provided at the time of, or prior to the final acceptance test.

- a. Provide one set of full size paper as-built drawings and schematics. The drawings must be prepared electronically and sized no less than the contract drawings. Furnish one set of CDs or DVDs containing software back-up and CAD based drawings in latest version of AutoCAD, and portable document formats of as-built drawings and schematics.
- b. Provide operating and maintenance (O&M) instructions.

3.10 ONSITE TRAINING

Conduct a training course for the responding fire department and operating and maintenance personnel as designated by the Contracting Officer. Training must be performed on two separate days (to accommodate different shifts of Fire Department personnel) for a period of 4 hours of normal working time and must start after the system is functionally complete and after the final acceptance test. The on-site training must cover all of the items contained in the approved Operating and Maintenance Instructions.

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SECTION 21 22 00.00 40

CLEAN AGENT FIRE EXTINGUISHING SYSTEMS
05/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM B88 (2020) Standard Specification for Seamless Copper Water Tube

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58 (2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

NFPA 101 (2021) Life Safety Code

NFPA 2001 (2018) Standard on Clean Agent Fire Extinguishing Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01 (2020; with Change 5) Fire Protection Engineering for Facilities

UNDERWRITERS LABORATORIES (UL)

UL 536 (2014; Reprint Dec 2019) Flexible Metallic Hose

UL 2166 (2017; Reprint Sep 2020) UL Standard for Safety Halocarbon Clean Agent Extinguishing System Units

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality

Control approval. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Partial submittals and submittals not fully complying with this specification section must be returned disapproved without review. SD-02, SD-03, and SD-05 must be submitted simultaneously.

Shop drawings (SD-02), product data (SD-03 and calculations (SD-05) must be prepared and signed by the clean agent designer and combined and submitted as one complete package. The QFPE must review the SD-02/SD-03/SD-05 submittal package for completeness and compliance with the Contract provisions prior to submission to the Government. The QFPE must provide a Letter of Confirmation that they have reviewed the submittal package for compliance with the contract provisions. This letter must include their professional engineer stamp and signature. Partial submittals and submittals not reviewed by the QFPE must be returned disapproved without review.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Previous Product Installation; G

SD-02 Shop Drawings

High-Pressure Cylinders; G

Piping Materials; G

Pipe Hangers and Supports; G

Pressure Alarm Switch; G

Nozzle; G

Manual Actuation Station; G

Installation Drawings; G

SD-03 Product Data

Escutcheons; G

Storage Batteries; G

Battery Charger; G

Air Sampling Smoke Detectors; G

Audible Alarms; G

Visual Alarms; G

Main Annunciator; G

Pressure-Relief Device; G

SD-05 Design Data

Design Analysis; G

Discharge Calculations; G

Relief Vent Sizing Calculation; G

SD-06 Test Reports

Test Procedure; G

Preliminary Tests; G

Formal Tests; G

Enclosure Fan Test; G

SD-07 Certificates

Certificates of Compliance

SD-10 Operation and Maintenance Data

Operating Instructions; G

Operation and Maintenance Manuals; G

SD-11 Closeout Submittals

Record Drawings; G

1.3 QUALITY CONTROL

Use State certified contractors to supervise installation and perform acceptance testing of the system in accordance with NFPA 2001.

Perform all work by, or under the direct supervision of the certified contractor, the same certified contractor providing work under Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE.

1.3.1 Special Hazards Suppression Systems

Provide the services of a Certified Special Hazards Design Specialist (CSHDS) thoroughly experienced in Clean Agent Suppression System installations on site, to perform or directly supervise the installation, make all necessary adjustments, and perform all tests.

A CSHDS is considered certified when the specialist holds a valid System Layout Certification, Level IV Certification from the National Institute for Certification in Engineering Technologies (NICET).

Certification of other recognized agencies with equivalent requirements may be considered. Provide evidence of the Contractor's State Certification and the basis of certification to the Contracting Officer for approval prior to any work being performed.

1.3.2 Previous Product Installation

Submit the names, locations, and client contact information of five

successful previous projects of similar size and scope that the installer has constructed using the manufacturer's submitted products for this project.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Design clean agent extinguishing system as per NFPA 2001 and UFC 3-600-01. Submit plans and calculations for approval before installation. Submit certificates of compliance for the following items showing conformance with the referenced standards contained in this section:

- a. Piping Materials and Supports
- b. High-Pressure Cylinders
- c. Escutcheons
- d. Pipe Hangers and Supports
- e. Pressure Alarm Switch
- f. Internal Cleaning and Swabbing of Pipe
- g. Releasing Solenoid

2.1.1 Installation Drawings

Submit installation drawings for Clean Agent Fire Protection Systems. Annotate clean agent extinguishing system piping layout with reference points for design. In field wiring diagrams, show locations of devices and points of the system. Prepare working drawings in accordance with the requirements for "Specifications, Plans and Approvals" as specified in NFPA 2001. Include data essential to the proper installation of each system. Integrate with the alarm and detection system specified.

Include details of equipment layout and design. Indicate the general physical layout of all controls, manual actuation stations, notification appliances, stop stations, and internal tubing and wiring details.

Give full consideration to built-in spaces, piping, electrical equipment, ductwork, and all other construction and equipment for the layout of the system.

2.1.2 Design Requirements

Submit design analysis and calculations for Fire-Protection Systems including spray areas, hazard by class, and pressure calculations.

Submit clean agent discharge calculations verifying total storage requirements, flooding concentrations, discharge times, flow through the piping network, pipe sizes, and nozzle orifice sizes, in accordance with the manufacturer's listed design manual and NFPA 2001.

Design the total flooding system to a concentration of and hold time in accordance with NFPA 2001 and the specific agent's listing requirements.

2.1.3 Equipment Approval

Provide devices and equipment of make and type listed by the Underwriters Laboratories, Inc. (UL), UL 2166, or Factory Mutual (FM) approved. In the UL and FM publications, consider the advisory provisions as mandatory. Reference to the "authority having jurisdiction", AHJ is interpreted as the NAVFAC MIDLANT Fire Protection Engineer.

Provide an approved high-pressure total flooding type Fire-Extinguishing system conforming to NFPA 2001 and UFC 3-600-01.

2.1.4 Performance Requirements

Provide construction type, test, and mark of high-pressure cylinders in accordance with U.S. Department of Transportation specifications for seamless steel cylinders.

Provide each cylinder with a safety device to relieve excess pressure safely, in advance of the rated cylinder test pressure. Devices are to be Interstate Commerce Commission approved frangible safety disks.

Provide cylinder support racks that anchor to walls and floors.

Main System: Arrange system for fully automatic and manually operated electric control operation, with operating controls of the enclosed release type to prevent accidental operation. Also provide for manual actuation stations, stop stations, and keyed override operations.

2.2 EQUIPMENT

Design and construct the system as a total-flood system to include a fixed supply of extinguishing agent connected to properly sized, fixed piping with fittings and nozzles to direct this agent into the protected area.

2.3 HALOCARBON CLEAN AGENT

The clean agent must be a halocarbon type clean agent. Design system for Class A and Class C fires. Use clean agent indicated and in concentration suitable for normally occupied areas. The clean agent must be one of the following:

- a. HFC-227ea (FM-200).
- b. FK-5-1-12 (Novec 1230).
- c. HFC-125 (Ecaro-25).

2.3.1 Flooding Concentration

The system must totally flood the protected area(s) providing a volumetric concentration of Clean Agent not less than, nor more than, allowed by NFPA 2001 for 70 degrees F.

2.3.1.1 Clean Agent Halocarbon Concentration

The Clean Agent concentration must be based upon not shutting down the heating, ventilation and air conditioning (HVAC) systems at the time of agent discharge. The required Clean Agent concentration must be maintained in the protected area(s) for a minimum of 10 minutes.

Clean agent must have a minimum of a 100% safety factor between extinguishing concentration and the No-observed-adverse-effect-level (NOAEL), an atmospheric lifetime of less than one week, and a global warming potential of less than 1.

2.3.2 Discharge Time

The maximum Clean Agent discharge time must be 10 seconds after a 30 second time delay.

2.3.3 Reserve Supplies

A reserve supply of Clean Agent is not required.

2.4 COMPONENTS

2.4.1 Piping

Provide only galvanized, ferrous piping, Schedule 40 manifolds and distribution piping materials conforming to ASTM A53/A53M, nonferrous drawn seamless copper tubing conforming to ASTM B88, and flexible metallic hose conforming to UL 536.

Provide fittings for changes in direction of piping and for all connections. Reduce pipe sizes in the fitting. Do not use flush bushings. Fuse brazed joints, when used, with an alloy with a melting point above 1,000 degrees F.

Provide pipe and fittings having a minimum bursting pressure of 5,000 psi. For 1/2 inch and 3/4 inch iron pipe size (ips), provide Schedule 40. For 1 inch or greater, use only Schedule 80 pipe. Standard malleable iron banded fittings or ductile iron fittings are to be used up through 3/4 inch ips. Use extra heavy malleable iron or ductile iron fittings through 2 inch ips. Use forged steel fittings in all sizes over 2 inches.

Permanently mark discharge nozzles to identify the nozzle and to show the equivalent single orifice diameter regardless of shape and number of orifices. Design discharge nozzles to uniformly distribute the clean agent throughout the hazard area.

2.4.1.1 Pipe Hangers And Supports

Provide pipe hangers and supports conforming to MSS SP-58, adjustable type, zinc-coated.

2.4.1.2 Pipe Sleeves

Provide sleeves where piping passes through masonry or concrete walls, floors, roofs and partitions. Use standard weight zinc coating for steel pipe sleeves in outside walls, below and above grade, in floor, and roof slabs. Zinc coat steel sleeves in partitions having a nominal weight of not less than 0.90 pounds per square foot. Ensure space between piping and the sleeve, is not less than 0.5-inch. Use sleeves of sufficient length to pass through the entire thickness of walls, partitions and slabs. Extend sleeves in floor slabs 2-inches above the finished floor. Pack space between the pipe and sleeve with asbestos free insulation and caulk at both ends of the sleeve with plastic waterproof cement.

2.4.2 Escutcheons

Provide approved-type escutcheons for piping passing through floors, walls, and ceilings, consisting of one-piece or split-type. Provide chrome plated escutcheons where pipe passes through finished ceilings. Other escutcheons may be steel or cast iron, with aluminum paint finish. Securely fasten escutcheons in place with setscrews or other positive means.

2.4.3 Supervisory Switch

2.4.3.1 Low Pressure Alarm Switch

Provide the clean agent tanks with a low pressure alarm switch to warn of clean agent tank depressurization.

2.4.4 Alarm Switch

Provide clean agent manifold with high pressure alarm switch to signal clean agent discharge.

2.4.5 Control Panel (RSFACU)

Provide a separate control panel for the clean agent system. Provide the suppression system control panel with power-on, alarm, supervisory, and trouble indicating lights plainly visible when the cabinet is closed. Ensure the following functions are accessible only by unlocking and opening the unit:

- a. Alarm Silence
- b. Trouble Silence
- c. Supervisory Silence
- d. Power On-Off (If standard by the manufacturer)
- e. Alarm/Trouble Acknowledge
- f. Auxiliary Devices (AHU shutdown relay) Maintenance By-pass Switches
- g. System Reset
- h. Manual Actuation Station

Provide the suppression system control panel with all components necessary to monitor and supervise all signaling line and initiating device circuits. When any detector, connected to the control panel is activated, activate the control panels visual alarm indication and audible signal. (This causes all notification appliances to be activated, including all associated auxiliary control functions.) The control panel is to visually indicate the addressable device or zone in alarm and transmit an alarm condition to the remote Central Fire Monitoring System. Separate audible and visual notification appliance circuits. Provide audible and visual notification appliance circuits having sufficient capacity to operate all devices connected, plus 25 percent minimum spare capacity. Visual notification appliances are to remain operational until the panel has been reset.

Provide a control panel containing all components necessary to monitor and supervise all supervisory device circuits. When any valve tamper switch, pressure switch, or other supervisory device connected to the control panel is activated, they are to activate the control panel supervisory visual indication and supervisory audible device. The control panel is to visually indicate the addressable device or zone in supervisory alarm and transmit a supervisory condition to the remote Central Fire Monitoring System.

Provide a control panel containing all components necessary to operate and supervise the circuits for annunciator panels indicated and auxiliary devices controlling equipment. Provide circuits for auxiliary control relays which are supervised to within 3-feet of the the device controlled in accordance with NFPA 101. Include a maintenance by-pass switch for all auxiliary control devices. Supervise the by-pass to report trouble when in the maintenance by-pass position.

Design the panel to monitor and report as trouble, open supervised circuits, ground faulted supervised circuits, removal of detector or device, removal or failure of control panel module, maintenance by-pass switch activated, loss of primary power, power supply trouble, low battery voltage, loss of battery voltage, and activation of the alarm silence switch. Identify all trouble signals by initiating notification appliance, auxiliary control, or signaling line device. Trouble signals are to activate the control panel trouble visual indication and trouble audible devices, and send a trouble signal to the remote Central Fire Monitoring System.

Provide alarm/trouble reset switches to reset a cleared device in alarm or trouble. Alarm or trouble signals are not to be self-restoring without activating the switch.

Alarm, supervisory, and trouble silence switches are to silence the alarm and trouble audible's. Either switch placed in other than the normal position is to provide the following:

- a. Report as an alarm, supervisory, or a trouble to the Central Fire Monitoring System.
- b. Transfer audible signal to a panel lamp visual indication.
- c. Re-ring the trouble audible if the problem has been cleared, but the switch has been left in the silence position.

When the alarm silencing switches are in the silence position, subsequent alarms are to reactivate the notification appliances, with the strobes remaining operational until the clean agent releasing control panel is reset.

Ensure the control panel is suitable for use with the detectors and manual alarm stations, and other preaction devices specified in this section.

Provide a control panel having a normally closed set of dry contacts, single pole, double throw (SPDT), which opens for trouble conditions and a normally open set of dry contacts (SPDT), which closes under alarm conditions for connection to the Central Fire Monitoring System.

Provide continuous duty relays with self-cleaning contacts of silver or an alloy of equivalent performance. Suitably protect supervisory relays

against dust by individual covers. For all relays that provide external functions, such as remote reporting, control device activation, and notification appliance activation, ensure at least one (1) set of space contacts are provided. Permanently mark relays with the coil resistance, operating-current range, and internal pin connections using standard pin numbers.

Provide steel construction control panel, terminal cabinets and battery cabinets (when used). Provide panel and cabinets with a hinged cover and an integral pin-tumbler cylinder lock with removable core that accepts the key presently in use with other control units existing in the area; lock core is provided by the government. Paint cabinets with a prime coat and one or more finish coats of scratch-resistant baked enamel. Provide a red finish coat unless otherwise indicated. Permanently affix an etched metal or engraved laminated plastic identification plate labeled, "Releasing Service Fire Alarm Control Unit", to the cabinet door of the control unit to identify the cabinet as a control system cabinet. For cabinets painted red, provide an identification plate with white letters on a black background. For cabinets not painted red, the identification plate is to have white letters on a red background.

Provide a system which operates from a power supply with 120 grounded Vac int and 24 Vdc output, satisfactorily with power input voltage varying from 85 to 110 percent of nominal value. Ensure that the power supply output is capable of powering all initiation, signaling, annunciation, and control devices during alarm condition with 25 percent minimum spare capacity. If supplied within the cabinet, ensure the power on-off switch will disconnect all power sources to the control panel, and that the on-off switch has DC rated contacts.

2.4.5.1 Secondary Power Supply

Provide batteries, charger, and power transfer equipment which supplies the means of automatically supplying the entire clean agent releasing system with battery backup power in event of a primary power system failure, and switches to battery power in the event of AC power failure, and switches back to AC power upon return of primary power. Provide a control panel which operates when the backup batteries are disconnected for any reason, and controls charging currents and floating voltage levels to maintain batteries in optimum condition. Provide capability to recharge batteries in event of discharge. Fuse wiring to protect against battery over-current and polarity reversal. Primary power, battery, or charging equipment failure is to activate a clean agent releasing control panel trouble signal and visual indication.

2.4.5.1.1 Storage Batteries

Provide sealed and spill-proof battery modules (no corrosive fumes). Utilize only batteries which are listed for clean agent releasing service and suitable for high discharge currents required under alarm conditions, sized to operate the suppression and detection system in normal supervisory condition for 48 hours minimum, then operate the system in the alarm mode for 15 minutes, minimum.

Provide calculations substantiating the battery capacity. Provide reliable separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts.

2.4.5.1.2 Battery Charger

Provide completely automatic high/low charging rate type charger capable of battery recovery from full discharge to full charge in 24 hours or less. Provide an ammeter for recording rate of charge and a voltmeter to indicate the state of battery charge. Provide a red pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided.

2.4.6 Manual Actuation Station

Provide actuation stations for systems at the exits from the protected areas. Ensure manual station operation causes the control panel to go into full alarm condition and discharge Clean Agent into the protected area following the adjustable time delay. Install stations of a type not subject to operation by jarring or vibration. Ensure stations have a dual action release configuration to prevent accidental system discharge. Break-glass-front stations are not permitted; however a pull lever break-glass-rod type is acceptable. Station color is yellow or orange. Place warning signs, "Agent Trade Name" manual release, at each station indicating that operation of the station initiates immediate Fire Suppression Agent discharge. Where building fire alarm pull stations are also mounted at the exits from the protected areas, separate them from Fire Suppression Agent actuation stations by at least 3-feet horizontally. Provide labels to clearly distinguish building fire alarm stations from Fire Suppression Agent stations. Ensure Fire Suppression Agent stations are a different color from building fire alarm pull stations.

2.4.7 Air Sampling Smoke Detectors

Design of the detection systems used for release of the clean agent systems is provided in specification Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE.

2.4.8 Stop Station

Provide stop stations as indicated on the Contract Drawings where activation of switch is to delay only equipment shutdown and agent discharge. Station is guarded, spring-loaded type which operates only when pressure is manually applied to the switch. Upon release of manual pressure, station de-activates allowing delayed functions to resume. After start of agent discharge, station has no effect. Activation of switch during normal (non-alarm) conditions causes activation of system trouble signals.

2.4.9 Alarm Signaling Devices

Provide each protected area with audible and visual alarms located where shown. Electrically supervise all alarm circuits. Provide separate and distinct audible and visual pre-discharge and discharge signals. Where the building is equipped with a separate fire evacuation alarm system, ensure the discharge signals is distinct from those used by the building fire evacuation system. Provide each signal device with a rigid plastic or metal identification sign with lettering a minimum of 1.5-inches high. Label the pre-discharge alarm "FIRE" and the discharge alarm "Fire Suppression Agent DISCHARGE." Locate post-discharge visual alarms outside all entrances to the protected areas, and provided with signs as indicated on the contract drawings.

2.4.9.1 Audible Alarms

a. Alarm horns

Provide surface mounted, vibrating type alarm horns suitable for use in an electrically supervised circuit that have a sound output rating of at least 90 decibels at 10 feet.

2.4.9.2 Visual Alarms

Surface mounted lamp assembly suitable for use in an electrically supervised circuit. Provide flashing stroboscopic type lamps, powered from the control panel alarm circuit. Provide lamps with a minimum of 50 candle power with a flash rate is between 60 and 120 flashes per minute. Protect lamps by a thermo-plastic lens, red for pre-discharge alarms and blue for discharge and post-discharge alarms. Visual alarms may be part of an audio-visual alarm assembly.

2.4.10 Main Annunciator

Annunciator is integral with the main control panel. Provide separate alarm and trouble lamps for each zone alarm initiating circuit located on the exterior of the cabinet door or visible through the cabinet door. Supervision is not required provided that a fault in the annunciator circuits results only in loss of annunciation and does not affect the normal functional operation of the remainder of the system. Ensure each lamp provides specific identification of the area by means of a permanent label. Do not use generic nondescript wording such as "Zone 1," or "Zone 2," for the label identifications.

2.4.10.1 Annunciation Zones

Arrange annunciation zones as follows: Telecom Room 110 and Telecom Room 216

2.5 ACCESSORIES

2.5.1 Electrical Work

Electrical work is specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control and fire alarm wiring.

2.5.1.1 Wiring

Provide control and fire alarm wiring, including connections to fire alarm systems, under this section and conform to NFPA 70. Use No. 12 AWG minimum wiring for 120 volt circuits. Use No. 16 AWG minimum wiring for IDC, NAC, and releasing circuits. Use No. 18 AWG minimum wiring for SLC circuits. Color code all wiring per the Rhode Island State color coding requirements. Use rigid metal conduit or intermediate metal conduit, except electrical metallic tubing may be used in dry locations not enclosed in concrete and where not subject to mechanical damage.

2.5.1.2 Operating Power

Use 120 Vac power, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all signal initiating, signal sounding, trouble signal and transmitter tripping

circuits. Provide secondary DC power supply for operation of system in the event of failure of the AC supply. Ensure transfer from normal to emergency power or restoration from emergency to normal power is fully automatic and does not cause transmission of a false alarm. Obtain AC operating power to control panel and battery charger from the line side of the incoming building power source ahead of all building services. Provide independent properly fused safety switch, with provisions for locking the cover and operating handle in the "POWER ON" position for these connections and locate adjacent to the main distribution panel. Paint switch box red and suitably identify by a lettered designation.

2.5.1.3 Conductor Identification

Identify all circuit conductors within each enclosure where a tap, splice or termination is made. Use plastic coated self sticking printed markers or by heat-shrink type sleeves for conductor identification. Attach the markers in a manner that does not permit accidental detachment. Properly identify control circuit terminations.

2.5.1.4 Releasing Solenoid

Solenoid must be UL Listed or FM Approved as compatible with the RSFACU.

PART 3 EXECUTION

3.1 INSTALLATION

Install materials and equipment in accordance with NFPA 2001 and UFC 3-600-01. Ensure each system is complete and ready for operation.

Conceal piping to the maximum extent possible. Inspect and test pipe; receive Contracting Officer approval before pipe is concealed.

Provide each system with an approved pressure-relief device designed to operate between 2,000 and 3,300 psi and located between the storage cylinder manifolds and any normally closed valve.

3.1.1 Relief Venting

Provide relief vent sizing calculations for both expected negative and positive room pressurization.

3.1.2 Fan Test

Provide enclosure fan test in accordance with NFPA 2001. A retention time of at least ten minutes must be achieved. The Clean Agent System Contractor must be an authorized user of the fan test equipment. The Clean Agent System Contractor must aid the General Contractor in determining how much additional room sealing is required to achieve the desired retention time; however, actual sealing is to be done by the General Contractor.

3.1.3 Initiating and Notification Devices

Refer to Contract Drawings for location, quantity, and mounting details of initiating and notification devices.

3.1.4 Warning Signs

Provide signs manufactured of 3-layer red-white-red micarta, engraved to show white uppercase letters on a red background, warning signs. Warning sign thickness is 1/8-inch thick with beveled edges.

3.1.4.1 Inside Protected Area

Refer to Contract Drawings for sign details and locations.

3.1.4.2 Outside Protected Area

Refer to Contract Drawings for sign details and locations.

3.1.4.3 Manual Activation Station and Stop Station

Refer to Contract Drawings for sign details and locations.

3.1.5 System Control

3.1.5.1 Controls

Provide an electrical and mechanical actuating control system contained in a fire alarm panel specified in Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATOIN SYSTEM, ADDRESSABLE as modified below.

3.1.5.2 Suppression System Safing/Disconnect Switch

Connect the positive and negative conductors of the Class B solenoid/actuator/electric release head circuitry in series to a lock switch. Provide and install the switch in an enclosure inside the facility. A clearly visible sign on the enclosure, or immediately adjacent, is to explicitly indicate its purpose as "FIRE SUPPRESSION SYSTEM SAFING SWITCH".

3.1.6 Electrical Work

Electrical work is specified in Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATOIN SYSTEM, ADDRESSABLE.

3.1.7 Operating Instructions

Submit operating instructions for Clean Agent Fire Protection Systems consisting of raised or embossed white letter on red rigid plastic or enameled steel background and of a size to permit them to be easily read.

Provide operating instructions at each remote control station. Instructions are to clearly indicate necessary steps for the operation of the system.

Submit six copies of the operation and maintenance manuals 30 days prior to testing the Clean Agent Fire Protection Systems. Update and resubmit data for final approval no later than 30 days prior to contract completion.

3.1.8 Field Painting

Touch-up painting is to match equipment manufacturer's original paint.

3.2 FIELD QUALITY CONTROL

Conduct testing to determine conformance with the requirements in the presence of the Contracting Officer.

3.2.1 Manufacturer's Field Service

Provide an experienced manufacturer's field engineer to supervise installation and testing of the system.

3.2.2 Test Procedure

Prepare and submit the clean agent system test procedure to the Contracting Officer for approval 30 days prior to the planned preliminary tests.

3.2.3 Preliminary Tests

Pneumatically test each piping system to at least 40 psi. After removing the source of pressurizing gas, the pressure in the pipe must not be less than 80 percent of the test pressure after 10 minutes in accordance with NFPA 2001. Use the discharge of breathing air from each system discharge nozzle to test discharge nozzles. Test remote control stations, and all other components and accessories individually to demonstrate proper functioning. At the completion of tests and corrections, submit a signed and dated certificate to the Contracting Officer attesting to the satisfactory completion of all testing and that the system is in operating condition.

3.2.4 Formal Tests

Provide the suppression agent, instruments, personnel, appliances, and equipment necessary for testing are furnished by the Contractor at his expense.

At a time agreed upon by the Government, the Government Fire Protection Engineer will witness formal tests and approve systems before they are accepted. Ensure the presence of an experienced technician regularly employed by the system installer during the testing. During the testing, repeat any of the required tests, as directed by the Contracting Officer. Perform a fan test witnessed by the Government wherein the enclosure integrity is required to perform in accordance with NFPA 2001, Annex C.

Provide the formal test results to the Contracting Officer.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Record Drawings

Upon completion, and before final acceptance of the work, submit a complete set of as-built (record) working drawings, including complete as-built circuit diagrams, of each clean agent system for record purposes. Provide record working drawings no smaller than 30 by 42 inches, reproducible with title block 8 by 4 inches similar to full size contract drawings in dwg.electronic format.

-- End of Section --

SECTION 21 30 00

FIRE PUMPS

04/08, CHG 1: 08/13

PART 1 GENERAL

1.1 SUMMARY

Except as modified in this Section or on the drawings, install fire pumps in conformance with NFPA 20, NFPA 70, and NFPA 72. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification governs. Devices and equipment for fire protection service must be UL Fire Prot Dir listed or FM APP GUIDE approved. Interpret all reference to the authority having jurisdiction to mean the Contracting Officer or the MIDLANT Division, Naval Facilities Engineering Systems Command, Fire Protection Engineer for Navy projects.

1.2 SEQUENCING

Pump starting pressures must be in accordance with NFPA 20 A.14.2.6.

1.2.1 Fire Pump

Fire pump must automatically operate when the pressure drops or manually when the starter is operated. Pump must continue to run until shut down manually or automatically. The fire pump must automatically stop operating when the system pressure reaches a stop pressure of at least 5 psi below the maximum churn pressure at the lowest available static pressure and after the fire pump has operated for the minimum pump run time of 10 minutes.

1.2.2 Pressure Maintenance Pump

Pressure maintenance pump must operate when the system pressure drops. Pump must automatically stop when the system pressure rises per NFPA 20 and after the pump has operated for the minimum pump run time specified herein.

1.3 FIRE PUMP INSTALLATION RELATED SUBMITTALS

The Fire Protection Specialist must prepare a list of the submittals, from the Contract Submittal Register, that relate to the successful installation of the fire pump(s), no later than 7 days after the approval of the Fire Protection Specialist and the Manufacturer's Representative. The submittals identified on this list must be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B31.1	(2020) Power Piping

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C606	(2015) Grooved and Shouldered Joints

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A194/A194M	(2020a) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A449	(2014; R 2020) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B135/B135M	(2017) Standard Specification for Seamless Brass Tube
ASTM D2000	(2018) Standard Classification System for Rubber Products in Automotive Applications
ASTM F436	(2011) Hardened Steel Washers

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20 (2019) Standard for the Installation of
Stationary Pumps for Fire Protection

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 72 (2019) National Fire Alarm and Signaling
Code

UNDERWRITERS LABORATORIES (UL)

UL 448 (2020) UL Standard for Safety Centrifugal
Stationary Pumps for Fire-Protection
Service

UL Fire Prot Dir (updated continuously online) Fire
Protection Equipment Directory

1.5 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Partial submittals and submittals not fully complying with this specification section must be returned disapproved without review. SD-02, SD-03, and SD-05 must be submitted simultaneously.

Shop drawings (SD-02), product data (SD-03) and calculations (SD-05) must be prepared and signed by the clean agent designer and combined and submitted as one complete package. The QFPE must review the SD-02/SD-03/SD-05 submittal package for completeness and compliance with the Contract provisions prior to submission to the Government. The QFPE must provide a Letter of Confirmation that they have reviewed the submittal package for compliance with the contract provisions. This letter must include their professional engineer stamp and signature. Partial submittals and submittals not reviewed by the QFPE must be returned disapproved without review.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

The MIDLANT Division, Naval Facilities Engineering Systems Command, Fire Protection Engineer, will review and approve all submittals in this section requiring Government approval.

SD-01 Preconstruction Submittals

Fire Pump Installation Related Submittals

Fire Protection Specialist; G

No later than 14 days after the Notice to Proceed and prior to the submittal of the fire pump installation drawings

SD-02 Shop Drawings

Installation Drawings; G

3 copies

As-Built Drawings; G

Piping Layout; G

Pump Room; G

SD-03 Product Data

Catalog Data; G

Spare Parts; G

Preliminary Tests; G

At least 14 days prior to the proposed date and time to begin Preliminary Tests

Field Tests; G

At least 2 weeks before starting field tests

Manufacturer's Representative; G

Field Training; G

SD-06 Test Reports

Preliminary Tests; G

3 copies of the completed Preliminary Tests Reports, no later than 7 days after the completion of the Preliminary Tests.

Navy Formal Inspection and Tests; G

SD-07 Certificates

Fire Protection Specialist; G

No later than 14 days after the Notice to Proceed and prior to the submittal of the fire pump installation drawings

Qualifications of Welders; G

Qualifications of Installer; G

Preliminary Test Certification; G

Final Test Certification; G

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G

At least 14 days prior to conducting field training

Flow Meter; G

Submit Data Package 2 for flow meter and controllers in
accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6 EXTRA MATERIALS

Submit Spare Parts data for each different item of equipment and material specified. The data must include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

1.7 QUALITY ASSURANCE

1.7.1 Fire Protection Specialist

Work specified in this section must be performed under the supervision of and certified by the Fire Protection Specialist. Submit the name and documentation of certification of the proposed Fire Protection Specialists. The Fire Protection Specialist must be an individual who is a registered professional engineer and must be the same Fire Protection Engineer who is responsible for Specification 21 13 13. The Fire Protection Specialist must be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and must have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.7.2 Qualifications of Welders

Submit certificates of each welder's qualifications prior to site welding; certifications must not be more than one year old.

1.7.3 Qualifications of Installer

Prior to installation, submit data for approval showing that the Contractor has successfully installed fire pumps and associated equipment of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. The data must include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

1.7.4 Preliminary Test Certification

When preliminary tests have been completed and corrections made, submit a signed and dated certificate with a request for a formal inspection and tests.

1.7.5 Final Test Certification

Concurrent with the Final Acceptance Test Report, submit certification by the Fire Protection Specialist that the fire pump installation is in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports. Submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

1.7.6 Manufacturer's Representative

Work specified in this section must be performed under the supervision of and certified by a representative of the fire pump manufacturer. Submit the name and documentation of certification of the proposed Manufacturer's Representative, concurrent with submittal of the Fire Protection Specialist Qualifications. The Manufacturer's Representative must be regularly engaged in the installation of the type and complexity of fire pump(s) specified in the Contract documents, and must have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.8 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes must be either capped or plugged until installed.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- a. Materials and equipment must be standard products of a manufacturer regularly engaged in the manufacture of such products and must essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.
- b. Submit manufacturer's catalog data included with the Fire Pump Installation Drawings for each separate piece of equipment proposed for use in the system. Catalog data must indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list that includes equipment description, model number and quantity must be provided. Catalog data for material and equipment must include, but not be limited to, the following:
 - (1) Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but must be submitted prior to the final tests.
 - (2) Pressure maintenance pump and controller.

- (3) Piping components.
- (4) Valves, including gate, check, globe and relief valves.
- (5) Gauges.
- (6) Hose valve manifold test header and hose valves.
- (7) Flow meter.
- (8) Restrictive orifice union.
- (9) Associated devices and equipment.

- c. All equipment must have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, contract number and accepted date; capacity or size; system in which installed and system which it controls and catalog number. Pumps and motors must have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump must have nameplates and markings in accordance with UL 448. Electric motor nameplates must provide the minimum information required by NFPA 70, Section 430-7.

2.2 FIRE PUMP

Fire pump must be electric motor driven. The pump capacity must be rated as indicated on the Contract Drawings. Fire pump must furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump must be centrifugal horizontal split case fire pump. Horizontal pump must be equipped with automatic air release devices. Pump must be automatic start and automatic stop. Pump must conform to the requirements of UL 448. Fire pump discharge and suction gauges must be liquid-filled type.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

2.3.1 General Requirements

Materials and Equipment must have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such must mean listed in UL Fire Prot Dir or FM APP GUIDE.

2.3.2 Alarms

Provide audible and visual alarms as required by NFPA 20 on the controller. Provide remote supervision as required by NFPA 20, in accordance with NFPA 72. Provide remote alarm devices located as indicated in Section 28 31 76. Alarm signal must be activated upon the conditions as indicated on the Contract Drawings. Exterior alarm devices must be weatherproof type. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is placed in OFF position.

2.4 UNDERGROUND PIPING COMPONENTS

Refer to Section 21 13 13 for requirements.

2.5 ABOVEGROUND PIPING COMPONENTS

2.5.1 Pipe Sizes 2.5 inches and Larger

2.5.1.1 Pipe

Refer to Section 21 13 13 for requirements.

2.5.1.2 Grooved Mechanical Joints and Fittings

Joints and fittings must be designed for not less than 175 psi service and must be the product of the same manufacturer. Fitting and coupling houses must be malleable iron conforming to ASTM A47/A47M, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12. Gasket must be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts must be heat-treated steel conforming to ASTM A183 and must be cadmium plated or zinc electroplated.

2.5.1.3 Flanges

Flanges must be ASME B16.5, Class 150 flanges. Flanges must be provided at valves, connections to equipment, and where indicated.

2.5.1.4 Gaskets

Gaskets must be AWWA C111/A21.11, cloth inserted red rubber gaskets.

2.5.1.5 Bolts

Bolts must be ASTM A449, Type 1. Bolts must extend no less than three full threads beyond the nut with bolts tightened to the required torque.

2.5.1.6 Nuts

Nuts must be ASTM A194/A194M, Grade 7.

2.5.1.7 Washers

Washers must meet the requirements of ASTM F436. Flat circular washers must be provided under all bolt heads and nuts.

2.5.2 Piping Sizes 2 inches and Smaller

2.5.2.1 Steel Pipe

Refer to Section 21 13 13 for requirements.

2.5.3 Pipe Hangers and Supports

Pipe hangers and support must be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE and must be the adjustable type. Finish of rods, nuts, washers, hangers, and supports must be zinc-plated after fabrication.

2.5.4 Valves

Valves must be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire protection service. Valves must have flange or threaded end connections.

2.5.4.1 Gate Valves and Control Valves

Gate valves and control valves must be outside screw and yoke (O.S.&Y.) type which open by counterclockwise rotation. Butterfly-type control valves are not permitted except where indicated on the Contract Drawings.

2.5.4.2 Tamper Switch

The suction control valves, the discharge control valves, valves to test header and flow meter, and the by-pass control valves must be equipped with valve tamper switches for monitoring by the fire alarm system.

2.5.4.3 Check Valve

Check valve must be clear open, swing type check valve with flange or threaded inspection plate.

2.5.4.4 Relief Valve

Relief valve must be spring operated type conforming to NFPA 20. A means of detecting water motion in the relief lines must be provided where the discharge is not visible within the pump house.

2.5.4.5 Circulating Relief Valve

An adjustable circulating relief valve must be provided for each fire pump in accordance with NFPA 20.

2.5.5 Hose Valve Manifold Test Header

Construct header of steel pipe. Provide ASME B16.5, Class 150 flanged inlet connection to hose valve manifold assembly. Provide approved bronze hose gate valve with 2.5 inch National Standard male hose threads with cap and chain; locate 3 feet above grade in the horizontal position for each test header outlet. Welding must be metallic arc process in accordance with ASME B31.1. The number of valves must be in accordance with NFPA 20.

2.5.6 Pipe Sleeves

A pipe sleeve must be provided at each location where piping passes entirely through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, and floors. Provide one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire barriers and fire floors, a fire seal must be provided between the pipe and the sleeve in accordance with Section 07 84 00 FIRESTOPPING.

- a. Sleeves in Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron pipe sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves provided that cavities in the core-drilled hole be completely grouted smooth.
- b. Sleeves in Other Than Masonry and Concrete Walls, Ceilings, Roofs, and

Floors: Provide galvanized steel sheet pipe not less than 0.90 psf.

2.5.7 Escutcheon Plates

Provide one-piece or split-hinge metal plates for piping entering floors, walls, and ceilings in exposed areas. Provide polished stainless steel or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces. Plates must be secured in place.

2.6 ELECTRIC MOTOR DRIVER

Motors, controllers, contactors, and disconnects must be provided with their respective pieces of equipment, as specified herein and must have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Controllers and contactors must have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work must be included under this section. Motor must conform to NEMA MG 1 Design B type. Integral size motors must be the premium efficiency type in accordance with NEMA MG 1. Motor horsepower must be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. The motor and fire pump controller must be fully compatible.

2.7 FIRE PUMP CONTROLLER

Controller must be the automatic type and UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire pump service. Pump must be arranged for automatic start and stop, and manual push-button stop. Automatic stopping must be accomplished only after all starting causes have returned to normal and after a minimum pump run time has elapsed. Controllers must be completely terminally wired, ready for field connections, and mounted in a NEMA Type 2 drip-proof enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Controller must be provided with voltage surge arresters installed in accordance with NFPA 20. Controller must be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller must be equipped with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures fall below 40 degrees F.

2.7.1 Controller for Electric Motor Driven Fire Pump

Controller must be electronic soft start starting type. An automatic transfer switch (ATS) must be provided for the fire pump. The ATS must comply with NFPA 20 and must be specifically listed for fire pump service. The ATS must transfer source of power to the alternate source upon loss of normal power. Controller must monitor pump running, loss of a phase or line power, phase reversal and pump room temperature. Alarms must be individually displayed in front of panel by lighting of visual lamps. Each lamp must be labeled with rigid etched plastic labels. Controller must be equipped with terminals for remote monitoring of pump running, pump power supply trouble (loss of power or phase and phase reversal), and pump room trouble (pump room temperature. Controller must be equipped with a 7-day electric pressure recorder with 24-hour spring

wound backup. The controller must be equipped with an externally operable isolating switch which manually operates the motor circuit. Means must be provided in the controller for measuring current for all motor circuit conductors.

2.8 PRESSURE SENSING LINE

A completely separate pressure sensing line must be provided for each fire pump and for the jockey pump. The sensing line must be arranged in accordance with Figure A-7-5.2.1. of NFPA 20. The sensing line must be 1/2 inch H58 brass tubing complying with ASTM B135/B135M. The sensing line must be equipped with two restrictive orifice unions each. Restricted orifice unions must be ground-face unions with brass restricted diaphragms drilled for a 3/32 inch. Restricted orifice unions must be mounted in the horizontal position, not less than 5 feet apart on the sensing line. Two test connections must be provided for each sensing line. Test connections must consist of two brass 1/2 inch globe valves and 1/4 inch gauge connection tee arranged in accordance with NFPA 20. One of the test connections must be equipped with a 0 to 300 psi water oil-filled gauge. Sensing line must be connected to the pump discharge piping between the discharge piping control valve and the check valve.

2.9 PRESSURE MAINTENANCE PUMP

2.9.1 General

Pressure maintenance pump must be electric motor driven, in-line vertical shaft, centrifugal type with a rating as indicated on the Contract Drawings. Pump must draft from the suction supply side of the suction pipe gate valve of the fire pump and must discharge into the system at the downstream side of the pump discharge gate valve. An approved indicating gate valve of the outside screw and yoke (O.S.&Y.) type must be provided in the maintenance pump discharge and suction piping. Liquid-filled water pressure gauge and approved check valve in the maintenance pump discharge piping must be provided. Check valve must be swing type with removable inspection plate.

2.9.2 Pressure Maintenance Pump Controller

Pressure maintenance pump controller must be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller must be completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller must be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. A sensing line must be provided connected to the pressure maintenance pump discharge piping between the control valve and the check valve. The sensing line must conform to paragraph, PRESSURE SENSING LINE. The sensing line must be completely separate from the fire pump sensing lines. An adjustable run timer must be provided to prevent frequent starting and stopping of the pump motor. The run timer must be set for 2 minutes.

2.10 JOINTS AND FITTINGS FOR COPPER TUBE

Wrought copper and bronze solder-joint pressure fittings must conform to ASME B16.22 and ASTM B75/B75M. Cast copper alloy solder-joint pressure fittings must conform to ASME B16.18. Cast copper alloy fittings for flared copper tube must conform to ASME B16.26 and ASTM B62. Brass or

bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings must be designed for not less than 125 psig service and must be the product of the same manufacturer. Grooved fitting and mechanical coupling housing must be ductile iron conforming to ASTM A536. Gaskets for use in grooved joints must be molded synthetic polymer of pressure responsive design and must conform to ASTM D2000 for circulating medium up to 239 degrees F. Grooved joints must conform to AWWA C606. Coupling nuts and bolts for use in grooved joints must be steel and must conform to ASTM A183.

2.11 PUMP BASE PLATE AND PAD

Provide a common base plate for each horizontal-shaft fire pump for mounting pump and driver unit. Construct the base plate of cast iron with raised lip tapped for drainage or welded steel shapes with suitable drainage. Provide each base plate for the horizontal fire pumps with a 1 inch galvanized steel drain line piped to the nearest floor drain. For vertical shaft pumps, pump head must be provided with a cast-iron base plate and must serve as the sole plate for mounting the discharge head assembly. Mount pump units and bases on a raised 4 inches reinforced concrete pad that is an integral part of the reinforced concrete floor.

2.12 FLOW METER

Meter must be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE as flow meters for fire pump installation with direct flow readout device. Flow meter must be capable of metering any waterflow quantities between 50 percent and 150 percent of the rated flow of the pumps. Arrange piping to permit flow meter to discharge to pump suction and to discharge through test header. The meter throttle valve and the meter control valves must be O.S. & Y. valves. Provide automatic air release if flow meter piping between pump discharge and pump suction forms an inverted "U". Meter must be of the venturi type.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist must periodically perform a thorough inspection of the fire pump installation, including visual observation of the pump while running, to assure that the installation conforms to the contract requirements. There must be no excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems. Inspection must include piping and equipment clearance, access, supports, and guards. Any discrepancy must be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered. The Fire Protection Specialist must witness the preliminary and final acceptance tests and, after completion of the inspections and a successful final acceptance test, must sign test results and certify in writing that the installation the fire pump installation is in accordance with the contract requirements.

3.3 INSTALLATION

Equipment, materials, workmanship, fabrication, assembly, erection, installation, examination, inspection and testing must be in accordance NFPA 20, except as modified herein. In addition, the fire pump and engine must be installed in accordance with the written instructions of the manufacturer.

3.3.1 Installation Drawings

Submit Fire Pump Installation Drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1/2 inch = 1 foot. Drawings must indicate equipment, piping, and associated pump equipment to scale. Indicate all clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment. Include a legend identifying all symbols, nomenclatures, and abbreviations. Indicate a complete piping and equipment layout including elevations and/or section views of the following:

- a. Fire pumps, controllers, piping, valves, and associated equipment.
- b. Sensing line for each pump including the pressure maintenance pump.
- c. Pipe hangers.
- d. Restraint of underground water main at entry-point to the building including details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.
- e. A one-line schematic diagram indicating layout and sizes of all piping, devices, valves and fittings.
- f. A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

3.3.2 Pump Room Configuration

Provide detail plan view of the pump room including elevations and sections showing the fire pumps, associated equipment, and piping. Submit working drawings on sheets not smaller than 24 by 36 inches; include data for the proper installation of each system. Show piping schematic of pumps, devices, valves, pipe, and fittings. Provide an isometric drawing of the fire pump and all associated piping. Show point to point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Show engine fuel and cooling system. Include:

- a. Pumps, drivers, and controllers
- b. Hose valve manifold test header
- c. Circuit diagrams for pumps
- d. Wiring diagrams of each controller

3.3.3 Accessories

Tank supports, piping offsets, fittings, and any other accessories required must be furnished as specified to provide a complete installation and to eliminate interference with other construction.

3.4 PIPE AND FITTINGS

Refer to 21 13 13.

3.5 ELECTRICAL WORK

Electric motor and controls must be in accordance with NFPA 20, NFPA 72 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Electrical wiring and associated equipment must be provided in accordance with NFPA 20 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage.

3.6 PIPE COLOR CODE MARKING

Color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS. Provide labeling on pump room piping to show water flow direction and pipe function (i.e., "Intake", "Discharge", "To Fire Dept. Connection", "To Bypass", "To Test Header", "To Sprinkler System"). Provide white painted stenciled letters and arrows, a minimum of 2 inches in height.

3.7 FLUSHING

The fire pump suction and discharge piping must be flushed at a rate in accordance with NFPA 20. No underground piping must be flushed by using the fire pumps. Flushing operations must continue until water is clear, but not less than 10 minutes. Submit a signed and dated flushing certificate before requesting field testing.

3.8 FIELD TESTS

Submit system diagrams that show the layout of equipment, piping, and storage units, and typed condensed sequence of operation, wiring and control diagrams, and operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system must be framed under glass or laminated plastic. After approval, these items must be posted where directed.

3.8.1 Hydrostatic Test

Piping must be hydrostatically tested in accordance with NFPA 20.

3.8.2 Preliminary Tests

Submit proposed procedures for Preliminary Tests prior to the proposed date and time to begin Preliminary Tests. The Fire Protection Specialist must take all readings and measurements. The Manufacturer's Representative and a representative of the fire pump controller manufacturer must witness the complete operational testing of the fire pump and drivers.

The fire pump controller manufacturer's representative must be an experienced technician employed by the respective manufacturers and capable of demonstrating operation of all features of respective components including trouble alarms and operating features. Fire pumps, drivers and equipment must be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests must ensure that pumps are operating at rated capacity, pressure and speed. Tests must include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves, and test of automatic power transfer, if provided. Pumps must run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, the corrections must be made and the entire preliminary test must be repeated. Submit Preliminary Tests Reports, to include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Report must be signed by the Fire Protection Specialist and the Manufacturer's Representative.

3.8.3 Navy Formal Inspection and Tests

The MIDLANT Division, Naval Facilities Engineering Systems Command, Fire Protection Engineer will witness formal tests and approve all systems before they are accepted. Submit the request for formal inspection at least 15 days prior to the date the inspection is to take place. An experienced technician regularly employed by the pump installer must be present during the inspection. Where pumps are engine driven, an experienced technician regularly employed by the engine manufacturer capable of demonstrating that all engine trouble alarms and operating features perform as required must be present. Submit proposed date and time to begin Navy Formal Inspection and Tests, with the Acceptance Procedures. Notification must be provided at least 14 days prior to the proposed start of the test. Notification must include a copy of the Contractor's Material & Test Certificates. Submit 3 copies of the completed Navy Formal Inspection and Tests Reports, no later than 7 days after the completion of the tests. All items in the reports must be signed by the Fire Protection Specialist and the Manufacturer's Representative. Test reports in booklet form (each copy furnished in a properly labeled three ring binder) showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report must indicate the final position of the controls and pressure switches. The test reports must include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump must be included in the report.

3.8.3.1 Full Water Flow Test

Acceptance test must include a full water flow test. The securing of all hoses and nozzles during the tests is the responsibility of the Contractor. Water flow testing must be conducted in a safe manner with no destruction to the existing facility or new construction. Tests must include 100 and 150 percent capacity flows and pressures, and no-flow

pressures for compliance with manufacturer's characteristic curves. At this inspection repeat the required tests as directed.

3.8.3.2 Correcting Defects

Correct defects in the work, and make additional tests until the Contractor has demonstrated that the system complies with the contract requirements.

3.8.3.3 Documentation of Test

Manufacturer's certified shop test characteristic curves for each pump being tested must be furnished by the Contractor at the time of the pump acceptance test.

3.8.4 Test Equipment

Provide all equipment and instruments necessary to conduct a complete final test, including 2.5 inch diameter hoses, playpipe nozzles, pitot tube gauges, portable digital tachometer, voltage and ampere meters, and calibrated oil-filled water pressure gauges. Provide all necessary supports to safely secure hoses and nozzles during the test. The Government will furnish water for the tests.

3.9 SYSTEM STARTUP

Fully enclose or properly guard coupling, rotating parts, gears, projecting equipment, etc. so as to prevent possible injury to persons that come in close proximity of the equipment. Conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests must be in excellent condition and must be safely anchored and secured to prevent any misdirection of the hose streams. Disinfect the section of underground piping from the water main to the backflow preventer.

Post operating instructions for pumps, drivers, controllers, and flow meters.

3.10 CLOSEOUT ACTIVITIES

3.10.1 Field Training

The Fire Protection Specialist and the Manufacturer's Representative must conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit the proposed schedule for field training at least 14 days prior to the start of related training. Training must be provided for a period of 8 hours of normal working time and must start after the fire pump installation is functionally complete and after the Final Acceptance Test. The field instruction must cover all of the items contained in the approved Operating and Maintenance Instructions. Submit manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance. The manuals must include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Data Package 3 must be submitted for fire pumps and drivers in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Each

service organization submitted must be capable of providing 4 hour onsite response to a service call on an emergency basis.

3.10.2 As-Built Drawings

Submit As-Built Drawings, no later than 14 days after completion of the Final Tests. Update the Fire Pump Installation Drawings to reflect as-built conditions after all related work is completed and must be on reproducible full-size mylar film.

3.11 PROTECTION

Carefully remove materials so as not to damage material which is to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction.

-- End of Section --

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SECTION 22 00 00

PLUMBING, GENERAL PURPOSE

11/15, CHG 3: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 1010 (2002) Self-Contained, Mechanically
Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.3/CSA 4.3 (2019) Gas-Fired Water Heaters Vol.III,
Storage Water Heaters With Input Ratings
Above 75,000 Btu Per Hour, Circulating and
Instantaneous

ANSI Z21.22/CSA 4.4 (2015; R 2020) Relief Valves for Hot Water
Supply Systems

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2 (2012; R 2017) Air Gaps in Plumbing
Systems (For Plumbing Fixtures and
Water-Connected Receptors)

ASME A112.6.1M (1997; R 2017) Floor Affixed Supports for
Off-the-Floor Plumbing Fixtures for Public
Use

ASME A112.6.3 (2019) Standard for Floor and Trench Drains

ASME A112.14.1 (2003; R 2017) Backwater Valves

ASME A112.19.2/CSA B45.1 (2018; ERTA 2018) Standard for Vitreous
China Plumbing Fixtures and Hydraulic
Requirements for Water Closets and Urinals

ASME A112.19.3/CSA B45.4 (2017; Errata 2017) Stainless Steel
Plumbing Fixtures

ASME A112.36.2M (1991; R 2017) Cleanouts

ASME B1.20.1 (2013; R 2018) Pipe Threads, General
Purpose (Inch)

ASME B16.5 (2020) Pipe Flanges and Flanged Fittings
NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B16.18 (2018) Cast Copper Alloy Solder Joint

Pressure Fittings

ASME B16.21	(2016) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2011) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.29	(2017) Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV
ASME B16.34	(2017) Valves - Flanged, Threaded and Welding End
ASME B16.50	(2013) Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
ASME B31.1	(2020) Power Piping
ASME B31.5	(2020) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2017) BPVC Section IV-Rules for Construction of Heating Boilers
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1
ASME CSD-1	(2016) Control and Safety Devices for Automatically Fired Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2016) Performance Requirements for Atmospheric Type Vacuum Breakers
ASSE 1003	(2009) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
ASSE 1010	(2004) Performance Requirements for Water Hammer Arresters (ANSI approved 2004)
ASSE 1011	(2004; Errata 2004) Performance Requirements for Hose Connection Vacuum Breakers (ANSI approved 2004)
ASSE 1012	(2009) Performance Requirements for

Backflow Preventer with an Intermediate
Atmospheric Vent - (ANSI approved 2009)

- ASSE 1013 (2011) Performance Requirements for
Reduced Pressure Principle Backflow
Preventers and Reduced Pressure Fire
Protection Principle Backflow Preventers -
(ANSI approved 2010)
- ASSE 1018 (2001) Performance Requirements for Trap
Seal Primer Valves - Potable Water
Supplied (ANSI Approved 2002)
- ASSE 1019 (2011; R 2016) Performance Requirements
for Wall Hydrant with Backflow Protection
and Freeze Resistance
- ASSE 1020 (2020) Performance Requirements for
Pressure Vacuum Breaker Assemblies

AMERICAN WATER WORKS ASSOCIATION (AWWA)

- AWWA B300 (2018) Hypochlorites
- AWWA B301 (2010) Liquid Chlorine
- AWWA C203 (2008) Coal-Tar Protective Coatings and
Linings for Steel Water Pipelines - Enamel
and Tape - Hot-Applied
- AWWA C606 (2015) Grooved and Shouldered Joints
- AWWA C651 (2014) Standard for Disinfecting Water
Mains
- AWWA C652 (2019) Disinfection of Water-Storage
Facilities
- AWWA C700 (2015) Cold-Water Meters - Displacement
Type, Metal Alloy Main Case
- AWWA C701 (2015) Cold-Water Meters - Turbine Type
for Customer Service

AMERICAN WELDING SOCIETY (AWS)

- AWS A5.8/A5.8M (2019) Specification for Filler Metals for
Brazing and Braze Welding
- AWS B2.2/B2.2M (2016) Specification for Brazing Procedure
and Performance Qualification

ASTM INTERNATIONAL (ASTM)

- ASTM A74 (2020) Standard Specification for Cast
Iron Soil Pipe and Fittings
- ASTM A105/A105M (2018) Standard Specification for Carbon
Steel Forgings for Piping Applications

ASTM A193/A193M	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A515/A515M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A888	(2020) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B42	(2020) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B88	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B306	(2020) Standard Specification for Copper Drainage Tube (DWV)
ASTM B370	(2012; R 2019) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B813	(2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM C564	(2020a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D1004	(2013) Initial Tear Resistance of Plastic Film and Sheeting

ASTM D2665	(2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2822/D2822M	(2005; R 2011; E 2011) Standard Specification for Asphalt Roof Cement, Asbestos-Containing
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	(2007; R 2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3311	(2017) Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D4551	(2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane
ASTM E1	(2014) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM E96/E96M	(2021) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM F409	(2017) Standard Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F477	(2014) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F891	(2016) Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core
ASTM F1760	(2016; R 2020) Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
ASTM F2389	(2019) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2018) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2012) Coupling for Use in Connection with

Hubless Cast Iron Soil Pipe and Fittings
for Sanitary and Storm Drain, Waste, and
Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015 (2016; 14/17) Copper Tube Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 515 (2017) Standard for the Testing, Design,
Installation, and Maintenance of
Electrical Resistance Heat Tracing for
Industrial Applications

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM (2017) Standard And Commentary Accessible
and Usable Buildings and Facilities

ICC IPC (2018) International Plumbing Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1 (2014) American National Standard for
Emergency Eyewash and Shower Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-25 (2018) Standard Marking System for Valves,
Fittings, Flanges and Unions

MSS SP-58 (2018) Pipe Hangers and Supports -
Materials, Design and Manufacture,
Selection, Application, and Installation

MSS SP-67 (2017; Errata 1 2017) Butterfly Valves

MSS SP-70 (2011) Gray Iron Gate Valves, Flanged and
Threaded Ends

MSS SP-71 (2018) Gray Iron Swing Check Valves,
Flanged and Threaded Ends

MSS SP-72 (2010a) Ball Valves with Flanged or
Butt-Welding Ends for General Service

MSS SP-78 (2011) Cast Iron Plug Valves, Flanged and
Threaded Ends

MSS SP-80 (2019) Bronze Gate, Globe, Angle and Check
Valves

MSS SP-85 (2011) Gray Iron Globe & Angle Valves
Flanged and Threaded Ends

MSS SP-110 (2010) Ball Valves Threaded,
Socket-Welding, Solder Joint, Grooved and

Flared Ends

NACE INTERNATIONAL (NACE)

NACE SP0169 (2013) Control of External Corrosion on
Underground or Submerged Metallic Piping
Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2018) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NEMA MG 1 (2018) Motors and Generators

NEMA MG 11 (1977; R 2012) Energy Management Guide for
Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2021) Standard for the Installation of
Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 372 (2016) Drinking Water System Components -
Lead Content

NSF/ANSI 14 (2019) Plastics Piping System Components
and Related Materials

NSF/ANSI 61 (2020) Drinking Water System Components -
Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man (2016) Firestopping: Plastic Pipe in Fire
Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (2010) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (2009) Hose Clamp Specifications

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star (1992; R 2006) Energy Star Energy
Efficiency Labeling System (FEMP)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SM 9223 (2004) Enzyme Substrate Coliform Test

PL 93-523 (1974; A 1999) Safe Drinking Water Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 430	Energy Conservation Program for Consumer Products
40 CFR 141.80	National Primary Drinking Water Regulations; Control of Lead and Copper; General Requirements

UNDERWRITERS LABORATORIES (UL)

UL 430	(2015; Reprint Feb 2018) UL Standard for Safety Waste Disposers
UL 499	(2014; Reprint Oct 2021) UL Standard for Safety Electric Heating Appliances

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; G

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Recycled Content for Steel Pipe; G

Recycled Content for Cast Iron Pipe; G

Fixtures

Flush Valve Water Closets; G

WaterSense Label for Flush Valve Water Closet; G

Lavatories; G

WaterSense Label for Lavatory Faucet; S

Kitchen Sinks; G

Service Sinks; G

Drinking-Water Coolers; G

Wheelchair Electric Water Cooler; G

Energy Star Label for Electric Water Cooler; S

Energy Star Label for Wheelchair Electric Water Cooler; S

WaterSense Label for Showerhead; S

Water Heaters; G

Gas Instantaneous Water Heater; G

Pumps; G

Backflow Prevention Assemblies; G

Shower Faucets; G

Heat Trace; G

Plumbing System

Diagrams, instructions, and other sheets proposed for posting.
Manufacturer's recommendations for the installation of bell and
spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed
to adjust each component and all field tests performed to prove
compliance with the specified performance criteria, completion and
testing of the installed system. Each test report shall indicate
the final position of controls.

Test of Backflow Prevention Assemblies; G.

Certification of proper operation shall be as accomplished in
accordance with state regulations by an individual certified by
the state to perform such tests. If no state requirement exists,
the Contractor shall have the manufacturer's representative test
the device, to ensure the unit is properly installed and
performing as intended. The Contractor shall provide written
documentation of the tests performed and signed by the individual
performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the
ASME Boiler and Pressure Vessel Code, the design, fabrication, and
installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Plumbing System; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract

documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical

operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Cement pipe shall contain recycled content as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Steel pipe shall contain a minimum of 25 percent recycled content, with a minimum of 16 percent post-consumer recycled content. Provide data identifying percentage of recycled content for steel pipe. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size and shall comply with NSF/ANSI 14, NSF/ANSI 61 and ASTM F2389. Polypropylene piping that will be exposed to UV light shall be provided with a Factory applied UV resistant coating. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61, Annex G or NSF 372. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Cast-iron pipe shall contain a minimum of 95 percent recycled content. Provide data identifying percentage of recycled content for cast iron pipe. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used underground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310
- b. Coupling for Steel Pipe: AWWA C606.
- c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- d. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.
- e. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.
- f. Solder Material: Solder metal shall conform to ASTM B32.
- g. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.
- h. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.
- i. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564.
- j. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.
- k. Flanged fittings including, but not limited to, flanges, bolts, nuts and bolt patterns shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M.
- l. Copper tubing shall conform to ASTM B88, Type K, L or M.

2.1.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be piston type.
- b. Copper, Sheet and Strip for Building Construction: ASTM B370.

- c. Asphalt Roof Cement: ASTM D2822/D2822M.
- d. Hose Clamps: SAE J1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.
- h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.
- i. Hypochlorites: AWWA B300.
- j. Liquid Chlorine: AWWA B301.
- k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.
- l. Thermometers: ASTM E1. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71

Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASME BPVC SEC IV, Part HLW-810: Requirements for Potable-Water Heaters Bottom Drain Valve
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on

spout and 3/4 inch male pipe thread on inlet.

2.3.2 Hose Bibbs

Bibbs shall be brass, with either straight or angle bodies, and shall be of the compression type. Body flange shall be provided with internal pipe thread to suit 3/4 inch pipe. Body shall be suitable for wrench grip. Faucet spout shall have 3/4 inch exposed hose threads. Faucet handle shall be securely attached to stem.

2.3.3 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22/CSA 4.4. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.4 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

2.4 FIXTURES

Water closet replacements in major renovations may have a flush valve of up to 1.6 GPF to accommodate existing plumbing capacity. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1 COMM. Vitreous China, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush valves and flushometer valves, shower

mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains shall be copper alloy with all visible surfaces chrome plated. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature.

2.4.1 Lavatories

Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate. Provide WaterSense labeled faucet with a maximum flow rate of 0.5 gpm at a flowing pressure of 60 psi. Water volume must be limited to 0.25 gal per metering cycle. Provide data identifying WaterSense label for lavatory faucet.

2.4.2 Flush Valve Water Closets

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, elongated bowl, wall mounted, wall outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide white solid plastic elongated open-front seat.

Water flushing volume of the water closet and flush valve combination shall not exceed 1.28 gallons per flush. Water closets must meet the EPA WaterSense product definition specified in http://www.epa.gov/watersense/partners/product_program_specs.html and must be EPA WaterSense labeled products. Provide data identifying WaterSense label for flush valve water closet.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls. Provide hard-wired solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.3 Wall Hung Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, straight back type, minimum dimensions of 19 inches, wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide 0.35 gpm aerator with faucet. Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top mounted washerless centerset sensor lavatory faucets.

2.4.4 Kitchen Sinks (S-1)

ASME A112.19.3/CSA B45.4, 16 gage stainless steel, under-mount, minimum dimensions as indicated on drawings, single compartment, with undersides fully sound deadened, with supply openings for use with top mounted washerless sink faucets, and with 3.5 inch drain outlet. Provide aerator

with faucet. Water flow rate shall not exceed 1.5 gpm when measured at a flowing water pressure of 60 psi. Provide stainless steel drain outlets and stainless steel cup strainers. Provide separate 1.5 inch P-trap. Provide top mounted washerless sink faucets with hose spray. Provide UL 430 waste disposer. Disposer shall be fractional horsepower, galvanized grinders with stainless steel swivel lugs.

2.4.5 Exam Room Sinks (S-2)

ASME A112.19.3/CSA B45.4, 16 gage stainless steel, under-mount, minimum dimensions as indicated on drawings, single compartment, with undersides fully sound deadened, with supply openings for use with top mounted washerless sink and with 3.5 inch drain outlet. Provide aerator with faucet. Water flow rate shall not exceed 1.5 gpm when measured at a flowing water pressure of 60 psi. Provide stainless steel drain outlets and stainless steel cup strainers. Provide separate 1.5 inch P-trap. Provide top mounted, lever operated, goose-neck sink faucet.

2.4.6 Laundry Tub (Double Bowl - Dive Locker)

Floor mounted double bowl (40 inch length x 24 inch width x 13-7/8 inch deep) molded stone appliance depth with white baked enamel steel legs. Provide cast iron 3 inch P-trap with a back mounted washerless 4 inch centerset two handle laundry faucets with aerator. Water flow rate shall not exceed 1.5 gpm when measured at at flowing water pressure at 60 psi.

2.4.7 Laundry Tub (Single Bowl - Boat Repair)

Floor mounted double bowl (24 inch length x 20 inch width x 13-3/8 inch deep) molded stone appliance depth with white baked enamel steel legs. Provide cast iron 3 inch P-trap with a back mounted washerless 4 inch centerset two handle laundry faucets with aerator. Water flow rate shall not exceed 1.5 gpm when measured at at flowing water pressure at 60 psi.

2.4.8 Drinking-Water Coolers

AHRI 1010 with more than a single thickness of metal between the potable water and the refrigerant in the heat exchanger, wall-hung, bubbler style, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor and basin, bottle filler and stainless steel cabinet. Bubblers shall be controlled by push levers or push bars, front mounted or side mounted near the front edge of the cabinet. Bubbler spouts shall be mounted at maximum of 36 inches above floor and at front of unit basin. Spouts shall direct water flow at least 4 inches above unit basin and trajectory parallel or nearly parallel to the front of unit. Provide ASME A112.6.1M concealed steel pipe chair carriers. Provide electric water cooler that is Energy Star labeled. Provide data identifying Energy Star label for electric water cooler.

2.4.9 Wheelchair Electric Water Cooler

AHRI 1010, wall-mounted bubbler style with ASME A112.6.1M concealed chair carrier, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 27 inch minimum knee clearance from front bottom of unit to floor and 36 inch maximum spout height above floor and bottle filler. Bubblers shall also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet. Provide electric water cooler that is Energy Star labeled. Provide data identifying Energy Star

label for wheelchair electric water cooler.

2.4.10 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

2.4.11 Emergency Eyewash and Shower

ANSI/ISEA Z358.1, floor supported free standing unit. Provide deluge shower head, stay-open ball valve operated by pull rod and ring or triangular handle. Provide eyewash and stay-open ball valve operated by foot treadle or push handle.

2.5 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall meet the above requirements.

Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 HEAT TRACE (Boat Repair)

Provide heat trace system consisting of a self-regulating, parallel resistance heating cables to maintain 40 degrees F piping temperature at 0 degrees F ambient temperature boat repair utilities as indicated on drawings. Contractor to provide sizing calculations for all required piping utilities. Refer to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS for insulation thickness and material properties.

2.6.1 Self-Regulating, Parallel-Resistance Heating Cables

- a. Heating Element: Pair of parallel No. 16 AWG, nickel-coated stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- b. Electrical Insulating Jacket: Flame-retardant polyolefin.
- c. Cable Cover: Tinned-copper, and polyolefin outer jacket with UV inhibitor.

- d. Maximum Operating Temperature (Power On): 150 degrees F.
- e. Maximum Exposure Temperature (Power Off): 185 degrees F.
- f. Capacities and Characteristics:
 - (1) Maximum Heat Output: 3 W/ft.
 - (2) Piping Diameter: As indicated on the Drawings.
 - (3) Number of Parallel Cables: As required to maintain specified conditions.
 - (4) Volts: 480V.
 - (5) Phase: 3.
 - (6) Hertz: 60.
 - (7) Provide number of heat trace circuits as required to heat trace all potable water and sanitary piping systems within the Boat Repair. Terminate all heat trace circuits in the heat trace control panel.

2.6.2 Heat Trace Control Panel

Heat Trace Panel with NEMA 4X enclosure, Incoming main disconnect 50 A, 480 volt, 3-phase, 4-wire, Common Alarm Output, Hand/Off/Auto Operation, integral 120 Volt Instrument Power, Current Monitoring, Ground Fault Equipment Protection, UL 508 construction and Thermostat Controlled Enclosure Heater for panel freeze protection down to 0 degrees F ambient. Provide BACnet communication interface to building control system specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC to communicate common alarms, current monitors for each heat trace circuit, and ground faults.

2.7 DRAINS

2.7.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping. Primer shall meet ASSE 1018.

2.7.1.1 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.7.2 Shower Faucets and Drain Fittings

Provide single control pressure equalizing shower faucets with body mounted from behind the wall with threaded connections. Provide ball joint self-cleaning shower heads. Provide WaterSense labeled showerhead with a maximum flow rate of (1.5 gpm). Provide data identifying WaterSense label for showerhead. Provide tubing mounted from behind the wall between bathtub faucets and shower heads. Provide separate globe valves or angle valves with union connections in each supply to faucet. Provide 1.5 inch copper alloy adjustable tubing with slip nuts and gaskets between bathtub overflow and drain outlet; chromium-plated finish is not required.

2.8 SHOWER PAN

Shower pan shall be curbed nonmetallic anti-slip material.

2.8.1 Plasticized Polyvinyl Chloride Shower Pan Material

Material shall be sheet form. The material shall be 0.040 inch minimum thickness of plasticized polyvinyl chloride or chlorinated polyethylene and shall be in accordance with ASTM D4551.

2.8.2 Nonplasticized Polyvinyl Chloride (PVC) Shower Pan Material

Material shall consist of a plastic waterproofing membrane in sheet form. The material shall be 0.040 inch minimum thickness of nonplasticized PVC and shall have the following minimum properties:

a. or ASTM D638:

Ultimate Tensile Strength:	2600 psi
Ultimate Elongation:	398 percent
100 Percent Modulus:	445 psi

b. ASTM D1004:

Tear Strength:	300 pounds per inch
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c. ASTM E96/E96M:

Permeance:	0.008 perms
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d. Other Properties:

Specific Gravity:	1.29
PVC Solvent:	Weldable
Cold Crack:	minus 53 degrees F
Dimensional stability	212 degrees F minus 2.5 percent
Hardness, Shore A:	89

2.9 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F409. Traps shall be without a cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.10 WATER HEATERS

Water heater types and capacities shall be as indicated. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III in PART 3 of this Section for each type of water heater specified. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure. The expansion tank size and acceptance volume shall be as indicated.

2.10.1 Gas Instantaneous Water Heater

Instantaneous Water Heater Gas fired, tankless, condensing, wall-mounted water heater. Unit shall be manufactured in accordance with ANSI Z21.10.3/CSA 4.3, and shall be certified for 150 psi working pressure. Unit shall have a steel case, dual stainless steel heat exchangers, premixed burner and negative pressure gas valve. 0.5-gallon buffer tank and circulation pump shall be integral to water heater. The water heater shall be controlled by an internal circuit board that monitors the inlet and outlet temperatures with installed thermistors, sensing and controlling flow rate to set point temperature with air-fuel ratio controls in order to maintain thermal combustion efficiency. Unit shall include safety features such as flame sensor system, high limit sensors, overheat prevention device, freeze protection mode, and fan motor rotation detector. Multi-system applications that require 2 to 32 units shall be installed by connecting the units using cable only connections.

2.10.2 Electric Instantaneous Water Heater

UL 499 and UL listed flow switch activated, tankless electric instantaneous water heater for wall mounting above laundry tub.

2.11 PUMPS

2.11.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. The pumps shall be direct-connected by an approved flexible coupling to a vertical electric motor having a continuous oiling device or packed bearings sealed against dirt and moisture. Motors shall be totally enclosed, fan-cooled of sizes as indicated and shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1. Each pump shall be fitted with a high-grade thrust bearing mounted above the floor. Each shaft shall have an alignment bearing at each end, and the suction inlet shall be between 3 and 6 inches above the sump bottom. The suction side of each pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed in a NEMA 250, Type 1 enclosure, shall start and stop each motor at predetermined water levels. Provide oil sensor probe and control panel. The discharge line from each pump shall be provided with a union or flange, a nonclog swing check valve, and a stop valve in an accessible location near the pump. Sump Pump control panel must connect to building DDC system.

2.12 COMPRESSED AIR SYSTEM

2.12.1 Air Compressors

Air compressor unit shall be a factory-packaged assembly, including 3 phase, 480 volt motor controls, switches, wiring, accessories, and motor controllers, in a NEMA 250, Type 4 enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each compressor shall start and stop automatically at upper and lower pressure limits of the system have a manual-off-automatic switch that when in the manual position, the compressor loads and unloads to meet the demand and, in the automatic position, a time delay relay shall allow the compressor to operate for an adjustable length of time unloaded, then stop the unit. Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with automatic alternation system. Each compressor motor shall be provided with an across-the-line-type magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensate before the air enters the receiver. Aftercoolers shall be either air- or water-cooled, as indicated. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve, which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

2.12.2 Lubricated Compressors

Compressors shall be two-stage, V-belt drive, capable of operating continuously against their designed discharge pressure, and shall operate at a speed not in excess of 1800 rpm. Compressors shall have the capacity and discharge pressure indicated. Compressors shall be assembled complete on a common subbase. The compressor main bearings shall be either roller or ball. The discharge passage of the high pressure air shall be piped to the air receiver with a copper pipe or tubing. A pressure gauge calibrated to 150 psi and equipped with a gauge cock and pulsation dampener shall be furnished for installation adjacent to pressure switches.

2.12.3 Air Receivers

Receivers shall be designed for 200 psi working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPVC SEC VIII D1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

2.12.4 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 125 psi, capacity as indicated.

2.12.5 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 125 psi and a maximum temperature of 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 to 125 psi. Regulator shall be sized as indicated.

2.13 DOMESTIC WATER SERVICE METER

The requirements for metering and submetering are specified in Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

Cold water meters 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, as provided by the local utility. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

Meters must be connected to the base wide energy and utility monitoring and control system (if this system exists) using the installation's advanced metering protocols.

2.14 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, corresponding to the applications in accordance with NEMA MG 11. In addition to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, provide polyphase, squirrel-cage medium induction motors with continuous ratings, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.15 MISCELLANEOUS PIPING ITEMS

2.15.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.15.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.15.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.15.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.15.3 Pipe Hangers (Supports)

Provide MSS SP-58 Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. All hangers and fasteners shall be 304L stainless steel.

Provide Type 40 insulation protection shield for insulated piping.

2.15.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

2.15.5 Labels

Provide labels for sensor operators at flush valves and faucets. Include the following information on each label:

- a. Identification of the sensor and its operation with graphic.
- b. Range of the sensor.
- c. Battery replacement schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A full port ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake

or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.3 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.4 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.5 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets and changes in direction where indicated and required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.6 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 125 psig working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3.2 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.3.3 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.3.4 Copper Tube and Pipe

- a. Brazed. Brazed joints shall be made in conformance with AWS B2.2/B2.2M, ASME B16.50, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.
- b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.
- c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with ICC IPC.

3.1.3.5 Plastic Pipe

PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.3.6 Other Joint Methods

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe

shall be made with transition fitting for the specific purpose.

3.1.5 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Coatings shall be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

3.1.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.6.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated

with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.1.6.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.6.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.6.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 6 inches in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

3.1.6.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs FLASHING REQUIREMENTS and WATERPROOFING, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.6.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.7 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.8 Supports

3.1.8.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.8.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if

they otherwise meet the requirements for type 18 inserts.

- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-58 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
 - (1) Be used on insulated pipe less than 4 inches.
 - (2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.
 - (3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.
- i. Horizontal pipe supports shall be spaced as specified in MSS SP-58 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
 - (1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
 - (2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
 - (3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- l. Pipe hangers on horizontal insulated pipe shall be the size of the

outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

- m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.
- n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.8.3 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.9 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.10 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or

stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 WATER HEATERS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

3.2.2 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.2.3 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be

made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure. Bumpers for water closet seats shall be installed on the flushometer spud.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1 COMM.

3.3.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.5.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.5.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall

be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.5.4 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.7 Heat Trace Cable Installation

Field apply heater tape and cut to fit as necessary, linearly along the length of pipe after piping has been pressure tested and approved by the Contracting Officer. Secure the heater to piping with either cable ties or fiberglass tape. Label thermal insulation on the outside, "Electrical Heat Trace".

Install power connection, end seals, splice kits and tee kit components in accordance with IEEE 515 to provide a complete workable system. Terminate connection to the thermostat and ends of the heat tape in a junction box. Ensure cable and conduit connections are raintight.

3.3.8 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 08 31 00 ACCESS DOORS AND PANELS.

3.3.9 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

3.3.10 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.3.11 Shower Pans

Before installing shower pan, subfloor shall be free of projections such as nail heads or rough edges of aggregate. Drain shall be a bolt-down, clamping-ring type with weepholes, installed so the lip of the subdrain is flush with subfloor.

3.3.11.1 General

The floor of each individual shower, the shower-area portion of combination shower and drying room, and the entire shower and drying room where the two are not separated by curb or partition, shall be made watertight with a shower pan fabricated in place. The shower pan material shall be cut to size and shape of the area indicated, in one piece to the maximum extent practicable, allowing a minimum of 6 inches for turnup on walls or partitions, and shall be folded over the curb with an approximate return of 1/4 of curb height. The upstands shall be placed behind any wall or partition finish. Subflooring shall be smooth and clean, with nailheads driven flush with surface, and shall be sloped to drain. Shower pans shall be clamped to drains with the drain clamping ring.

3.3.11.2 Plasticized Chlorinated Polyethylene Shower Pans

Corners of plasticized chlorinated polyethylene shower pans shall be folded against the upstand by making a pig-ear fold. Hot-air gun or heat lamp shall be used in making corner folds. Each pig-ear corner fold shall be nailed or stapled 1/2 inch from the upper edge to hold it in place. Nails shall be galvanized large-head roofing nails. On metal framing or studs, approved duct tape shall be used to secure pig-ear fold and membrane. Where no backing is provided between the studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding 1/2 inch from upper edge. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it will be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Surfaces to be solvent-welded shall be clean. Surfaces to be joined with xylene shall be initially sprayed and vigorously cleaned with a cotton cloth, followed by final coating of xylene and the joining of the surfaces by roller or equivalent means. If ambient or membrane temperatures are below 40 degrees F the membrane and the joint shall be heated prior to application of xylene. Heat may be applied with hot-air gun or heat lamp, taking precautions not to scorch the membrane. Adequate ventilation and wearing of gloves are required when working with xylene. Membrane shall be pressed into position on the drain body, and shall be cut and fit to match so that membrane can be properly clamped and an effective gasket-type seal provided. On wood subflooring, two layers of 15 pound dry felt shall be installed prior to installation of shower pan to ensure a smooth surface for installation.

3.3.11.3 Nonplasticized Polyvinyl Chloride (PVC) Shower Pans

Nonplasticized PVC shall be turned up behind walls or wall surfaces a distance of not less than 6 inches in room areas and 3 inches above curb level in curbed spaces with sufficient material to fold over and fasten to outside face of curb. Corners shall be pig-ear type and folded between pan and studs. Only top 1 inch of upstand shall be nailed to hold in place. Nails shall be galvanized large-head roofing type. Approved duct tape shall be used on metal framing or studs to secure pig-ear fold and membrane. Where no backing is provided between studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding at top inch of upstand. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it is to be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Trim for drain shall be exactly the size of drain opening. Bolt holes shall be pierced to accommodate bolts with a tight fit. Adhesive shall be used between pan and subdrain. Clamping ring shall be bolted firmly. A small amount of gravel or porous materials shall be placed at weepholes so that holes remain clear when setting bed is poured. Membrane shall be solvent welded with PVC solvent cement. Surfaces to be solvent welded shall be clean (free of grease and grime). Sheets shall be laid on a flat surface with an overlap of about 2 inches. Top edge shall be folded back and surface primed with a PVC primer. PVC cement shall be applied and surfaces immediately placed together, while still wet. Joint shall be lightly rolled with a paint roller, then as the joint sets shall be rolled firmly but not so hard as to distort the material. In long lengths, about 2 or 3 feet at a time shall be welded. On wood subflooring, two layers of 15 pound felt shall be installed prior to installation of shower pan to ensure a smooth surface installation.

3.4 VIBRATION-ABSORBING FEATURES

3.4.1 Foundation-Mounted Compressors

Foundation attachment shall be as recommended by the compressor manufacturer.

3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

3.6 IDENTIFICATION SYSTEMS

3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.6.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.6.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room.

3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.8.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.8.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment

shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.8.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.
- b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.
- c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure and reasons for choosing this option in lieu of the smoke test to the Contracting Officer for approval.

- a. Drainage and Vent Systems Test. The final test shall include a smoke test.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically

designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9.1.2 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 1 inch for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

3.9.1.3 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 150 psig and hold this pressure for 2 hours with no drop in pressure.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with hot potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer or the designated representative shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.9.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Flow rates on fixtures must not exceed those stated in PART 2 of this Section. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.

- e. Pump suction and discharge pressures.
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.
- j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

3.9.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take additional samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer.

Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with

EPA SM 9223. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.9.6 OPTIONAL DISINFECTION METHOD

Disinfect new potable water piping and affected portions of existing potable water piping with geothermal water. Geothermal water shall be not less than 194 degrees F and contact time shall be not less than 30 minutes. After disinfection, thoroughly flush new portable water piping and affected portions of existing potable water piping with the chlorinated base water supply for a minimum of two hours.

3.10 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.11 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 70 degrees F delta T.

SL = Standby loss is maximum (Btu/h) based on a 70 degrees F temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

3.11.1 Instantaneous Water Heater

3.11.1.1 Gas

- a. Rating of 4,000 Btu/h/gal and greater and less than 2 gallons with an input greater than 50,000 Btu/h and less than 200,000 Btu/h shall have a minimum energy factor (EF) of 0.62-0.0019V per 10 CFR 430.
- b. Rating of 4,000 Btu/h/gal and greater and less than 10 gallons with an input of 200,000 Btu/h and greater shall have a minimum thermal efficiency (ET) of 80 percent per ANSI Z21.10.3/CSA 4.3
- c. Rating of 4,000 BTU/h/gal and greater and 10 gallons and greater with

an input of 200,000 Btu/h and greater shall have a minimum thermal efficiency (ET) of 80 percent and the maximum SL shall be $Q/800+110 \times (V^{1/2})$ per ANSI Z21.10.3/CSA 4.3

3.12 TABLES

TABLE I						
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS						
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.	X		X		
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888. Pipe and fittings shall be marked with the CISPI trademark.		X		X	
3	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14					
4	Seamless copper pipe, ASTM B42					X
5	Copper drainage tube, (DWV), ASTM B306					X
6	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29					X
7	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23					X

TABLE I						
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS						
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
8	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D2665, ASTM F891, (Sch 40) ASTM F1760	X		X		
<p>SERVICE:</p> <p>A - Underground Building Soil, Waste and Storm Drain</p> <p>B - Aboveground Soil, Waste, Drain In Buildings</p> <p>C - Underground Vent</p> <p>D - Aboveground Vent</p> <p>E - Condensate</p> <p>* - Hard Temper</p>						

TABLE II						
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS						
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
1	Malleable-iron threaded fittings:ASME B16.3 for use with Item 2			X		X
2	Steel pipe:Seamless, black, ASTM A53/A53M, Type S, Grade B			X		X
3	Seamless copper water tube, ASTM B88, ASTM B88M	X**	X**		X***	
4	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22	X	X		X	

TABLE II						
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS						
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
5	Cast copper alloy solder-joint pressure fittings, ASME B16.18	X	X		X	
	SERVICE: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground C - Compressed Air Lubricated D - Cold Water Service Belowground E - Sump Pump Discharge Indicated types are minimum wall thicknesses. ** - Type L - Hard *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors **** - In or under slab floors only brazed joints					

TABLE III				
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT				
<u>FUEL</u>	<u>STORAGE CAPACITY GALLONS</u>	<u>INPUT RATING</u>	<u>TEST PROCEDURE</u>	<u>REQUIRED PERFORMANCE</u>
C. Instantaneous Water Heater				
Gas	4,000 (btu/h)/gal and 2 gal max.	50,000 Btu/h min 200,000 Btu/h max.	10 CFR 430	EF = 0.62-0.0019V
Gas	4,000 (btu/h)/gal and 2 gal max.	200,000 Btu/h min.	ANSI Z21.10.3/CS	ET = 80 percent
Gas	4,000 (btu/h)/gal and 2 gal max.	200,000 Btu/h min.	ANSI Z21.10.3/CS	ET = 80 percent SL = $(Q/800+110 \times (V^{1/2}))$
TERMS: EF = Energy factor, minimum overall efficiency. ET = Minimum thermal efficiency with 70 degrees F delta T. SL = Standby loss is maximum Btu/h based on a 70 degree F temperature difference between stored water and ambient requirements. V = Rated storage volume in gallons Q = Nameplate input rate in Btu/h				

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SECTION 23 03 00.00 20

BASIC MECHANICAL MATERIALS AND METHODS

08/10, CHG 3: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B117 (2019) Standard Practice for Operating
Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

NEMA MG 10 (2017) Energy Management Guide for
Selection and Use of Fixed Frequency
Medium AC Squirrel-Cage Polyphase
Induction Motors

NEMA MG 11 (1977; R 2012) Energy Management Guide for
Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Divisions: 21, FIRE SUPPRESSION; 22, PLUMBING; and 23, HEATING, VENTILATING, AND AIR CONDITIONING of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use must include applications of equipment and materials under similar circumstances and of similar size. The product

must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.3 Service Support

The equipment items must be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations must be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.4 Manufacturer's Nameplate

For each item of equipment, provide a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions must be considered mandatory, the word "should" is interpreted as "must." Reference to the "code official" must be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" must be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" must be interpreted to mean the "lessor." References to the "permit holder" must be interpreted to mean the "Contractor."

1.3.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, must be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage

before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors must conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and must have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work must be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment must be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.6 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations must conform to IEEE C2, NFPA 70, and requirements specified herein.

1.6.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors are not to be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits must be provided under Division 26, except internal wiring for components of package equipment must be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.6.2 High Efficiency Motors

1.6.2.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors must be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.6.2.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors must be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings must meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.6.3 Three-Phase Motor Protection

Provide controllers for motors rated one 1 horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors must be thoroughly familiar with all parts of the installation and must be trained in operating theory as well as practical operation and maintenance work.

Instruction must be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished must be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.8 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting must be factory applied or shop applied, and must be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 500 hours in a salt-spray fog test, except that equipment located outdoors must withstand 6,000 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with ASTM B117, and for that test the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment must not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system must be designed for the temperature service.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F must be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat must be aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F must receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of 1 mil; and two coats of enamel applied to a minimum dry film thickness of 1 mil per coat.
- b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F must receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.
- c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F must receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC
11/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 203 (1990; R 2011) Field Performance
Measurements of Fan Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 62.1 (2010) Ventilation for Acceptable Indoor
Air Quality

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (2002; 6th ed) National Standards for
Total System Balance

AABC MN-4 (1996) Test and Balance Procedures

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV (2006) Procedural Standards for
Measurements and Assessment of Sound and
Vibration

NEBB PROCEDURAL STANDARDS (2015) Procedural Standards for TAB
(Testing, Adjusting and Balancing)
Environmental Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA 1780 (2002) HVAC Systems - Testing, Adjusting
and Balancing, 3rd Edition

SMACNA 1858 (2004) HVAC Sound And Vibration Manual -
First Edition

SMACNA 1972 CD (2012) HVAC Air Duct Leakage Test Manual -
2nd Edition

1.2 DEFINITIONS

- a. AABC: Associated Air Balance Council
- b. COTR: Contracting Officer's Technical Representative

- c. DALT: Duct air leakage test
- d. DALT'd: Duct air leakage tested
- e. HVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling
- f. NEBB: National Environmental Balancing Bureau
- g. Out-of-tolerance data: Pertains only to field acceptance testing of Final DALT or TAB report. When applied to DALT work, this phase means see paragraph 3.4 TAB PROCEDURES for allowable measurement variation.
- h. Season of maximum heating load: The time of year when the outdoor temperature at the project site remains within plus or minus 30 degrees Fahrenheit of the project site's winter outdoor design temperature, throughout the period of TAB data recording.
- i. Season of maximum cooling load: The time of year when the outdoor temperature at the project site remains within plus or minus 5 degrees Fahrenheit of the project site's summer outdoor design temperature, throughout the period of TAB data recording.
- j. Season 1, Season 2: Depending upon when the project HVAC is completed and ready for TAB, Season 1 is defined, thereby defining Season 2. Season 1 could be the season of maximum heating load, or the season of maximum cooling load.
- k. Sound measurements terminology: Defined in AABC MN-1, NEBB MASV, or SMACNA 1858 (TABB).
- l. TAB: Testing, adjusting, and balancing (of HVAC systems)
- m. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed
- n. TAB Agency: TAB Firm
- o. TAB team field leader: TAB team field leader
- p. TAB team supervisor: TAB team engineer
- q. TAB team technicians: TAB team assistants
- r. TABB: Testing Adjusting and Balancing Bureau

1.2.1 Similar Terms

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results.

The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS			
Contract Term	AABC Term	NEBB Term	TABB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems	International Standards for Environmental Systems Balance
TAB Specialist	TAB Engineer	TAB Supervisor	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures	Field Readiness Check & Prelim. Field Procedures

1.3 WORK DESCRIPTION

The work includes duct air leakage testing (DALT) and testing, adjusting, and balancing (TAB) of new heating, ventilating, and cooling (HVAC) air and water distribution systems including equipment and performance data, ducts, and piping which are located within, on, under, between, and adjacent to buildings, including records of existing conditions.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Firm's qualifications. Comply with requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) as supplemented and modified by this specification section. All recommendations and suggested practices contained in the TAB procedural standards are considered mandatory.

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct DALT testing in compliance with the requirements specified in SMACNA 1972 CD, except as supplemented and modified by this section. Conduct DALT and TAB work in accordance with the requirements of this section.

1.3.1 Air Distribution Systems

Test, adjust, and balance systems (TAB) in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.2 Water Distribution Systems

TAB system in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to water distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. At Contractor's option and with Contracting Officer's written approval, the piping systems may be insulated before systems are TAB'd.

Terminate piping insulation immediately adjacent to each flow control

valve, automatic control valve, or device. Seal the ends of pipe insulation and the space between ends of pipe insulation and piping, with waterproof vapor barrier coating.

After completion of work under this section, insulate the flow control valves and devices as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.3 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings:

1. A unique number or mark for each piece of equipment or terminal.
2. Air quantities at air terminals.
3. Air quantities and temperatures in air handling unit schedules.
4. Water quantities and temperatures in thermal energy transfer equipment schedules.
5. Water quantities and heads in pump schedules.
6. Water flow measurement fittings and balancing fittings.
7. Ductwork Construction and Leakage Testing Table that defines the DALT test requirements, including each applicable HVAC duct system ID or mark, duct pressure class, duct seal class, and duct leakage test pressure.

Submit three copies of the TAB Schematic Drawings and Report Forms to the Contracting Officer, no later than 21 days prior to the start of TAB field measurements.

1.3.4 Related Requirements

Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

SD-03 Product Data

Equipment and Performance Data; G

TAB Related HVAC Submittals; G

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB team engineer .

SD-06 Test Reports

Completed Pre-Final DALT Report; G

Certified Final DALT Report; G

SD-07 Certificates

Independent TAB Agency and Personnel Qualifications; G

TAB Pre-Field Engineering Report; G

1.5 QUALITY ASSURANCE

1.5.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to Contracting Officer for approval:

a. Independent AABC or NEBB or TABB TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

1.5.1.1 TAB Standard

Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations.

All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures must be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are considered mandatory, including the latest requirements of ASHRAE 62.1.

1.5.1.2 Qualifications

a. TAB Firm

The TAB Firm must be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications.

Certification must be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor must immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm will be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor.

These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm must be a prime subcontractor of the Contractor and be financially and corporately independent of the mechanical subcontractor, reporting directly to and paid by the Contractor.

b. TAB Specialist

The TAB Specialist must be either a member of AABC, an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification must be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, immediately

notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist will be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

c. TAB Specialist Responsibilities

TAB Specialist responsibilities include all TAB work specified herein and in related sections under his direct guidance. The TAB specialist is required to be onsite on a daily basis to direct TAB efforts. The TAB Specialist must participate in the commissioning process.

1.5.1.3 TAB Related HVAC Submittals

The TAB Specialist must prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. Accompany the submittals identified on this list with a letter of approval signed and dated by the TAB Specialist when submitted to the Government. Ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

1.5.2 Responsibilities

The Contractor is responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate TAB execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in the paragraph TAB SUBMITTAL AND WORK SCHEDULE.

1.5.2.1 Contractor

- a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by a group meeting the requirements specified in the paragraph TAB PERSONNEL QUALIFICATION REQUIREMENTS.
- b. Pre-DALT/TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor, mechanical contractor, electrical contractor, and automatic temperature controls contractor.
- c. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB agency:
 - (1) Contract drawings and specifications
 - (2) Approved submittal data for equipment
 - (3) Construction work schedule
 - (4) Up-to-date revisions and change orders for the previously listed items

- d. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in the paragraph TAB SUBMITTAL AND WORK SCHEDULE is met.

- e. Coordination of supporting personnel:

Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the DALT and the TAB field measurement work.

Provide equipment mechanics to operate HVAC equipment and ductwork mechanics to provide the field designated test ports to enable TAB field team to accomplish the DALT and the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the DALT and the TAB field work.

Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.

- f. Deficiencies: Ensure that the TAB Agency supervisor submits all Design/Construction deficiency notifications directly to the Contracting officer within 3 days after the deficiency is encountered. Further, ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.
- g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB team supervisor in the design review report.
- h. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. Do not allow the TAB team to commence TAB field work until all of the following are completed.
 - (1) HVAC system installations are fully complete.
 - (2) HVAC prerequisite checkout work lists specified in the paragraph PRE-FIELD TAB ENGINEERING REPORT are completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved prerequisite HVAC work checklist.
 - (3) DALT field checks for all systems are completed.
 - (4) HVAC system filters are clean for Season 1 TAB field work.
- i. Advance notice: Furnish to the Contracting Officer with advance written notice for the commencement of the DALT field work and for the commencement of the TAB field work.
- j. Insulation work: For required DALT work, ensure that insulation is not installed on ducts to be DALT'd until DALT work on the subject ducts is complete. Later, ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.

1.5.2.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of the paragraph INDEPENDENT TAB AGENCY PERSONNEL QUALIFICATIONS. The work to be performed by the TAB agency is limited to testing, adjusting, and balancing of HVAC air and water systems to satisfy the requirements of this specification section.

1.5.2.3 TAB Team Supervisor

- a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.
- b. Pre-DALT/TAB meeting: Attend meeting with Contractor.
- c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.
- d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, the during the DALT or TAB field work.
- e. Pre-field DALT preliminary notification: Monitor the completion of the duct installation of each system and provide the necessary written notification to the Contracting Officer.
- f. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.
- g. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report is submitted.
- h. Technical assistance for DALT work.
 - (1) Technical assistance: Provide immediate technical assistance to TAB field team.
 - (2) DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being implemented and to confirm the accuracy of the Pre-final DALT Report data which has been reported. Also, perform sufficient evaluation to allow the TAB supervisor to issue certification of the final report. Conduct the site visit full-time for a minimum

of one 8 hour workday duration.

- i. Final DALT report: Certify the DALT report. This certification includes the following work:
 - (1) Review: Review the Pre-final DALT report data. From these field reports, prepare the Certified Final DALT report.
 - (2) TAB Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.
 - j. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.
 - (1) TAB field visit: At the midpoint of the Season 1 and Season 2 TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration.
 - (2) TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration. Review the TAB final report data and certify the TAB final report.
 - k. Certified TAB report: Certify the TAB report. This certification includes the following work:
 - (1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.
 - (2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.
 - l. Design/Construction deficiencies: Within 3 working days after the TAB Agency has encountered any design or construction deficiencies, the TAB Supervisor must submit written notification directly to the Contracting Officer, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency must issue notice and request direction in the notification submittal.
 - m. TAB Field Check: The TAB team supervisor must attend and supervise Season 1 TAB field check.
- 1.5.2.4 TAB Team Field Leader
- a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, EXECUTION.
 - b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.
 - c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work

items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

1.5.3 TAB Pre-Field Engineering Report

Submit report containing the following information:

- a. Step-by-step TAB procedure:
 - (1) Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.
 - (2) Air System Diagrams: Use the contract drawings and duct fabrication drawings if available to provide air system diagrams in the report showing the location of all terminal outlet supply, return, exhaust and transfer registers, grilles and diffusers. Use a key numbering system on the diagrams which identifies each outlet contained in the outlet airflow report sheets. Show intended locations of all traverses and static pressure readings.
 - (3) Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.
- b. Pre-field data: Submit AABC or NEBB or SMACNA 1780 data report forms with the following pre-field information filled in:
 - (1) Design data obtained from system drawings, specifications, and approved submittals.
 - (2) Notations detailing additional data to be obtained from the contract site by the TAB field team.
 - (3) Designate the actual data to be measured in the TAB field work.
 - (4) Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which instruments the choice will be made. Place the instrument key number in the blank space where the measured data would be entered.
- c. Prerequisite HVAC work checkout list: Provide a list of inspections and work items which are to be completed by the Contractor. This list must be acted upon and completed by the Contractor and then submitted and approved by the Contracting Officer prior to the TAB team coming to the contract site.

At a minimum, a list of the applicable inspections and work items listed in the NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" must be provided for each separate system to be TAB'd.

1.5.4 Test Reports

1.5.4.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance the following requirements:

- a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA 1972 CD. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Include node numbers in the completed report forms to identify each duct section. The TAB supervisor must review and certify the report.
- b. The TAB supervisor must include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition, provide the ductwork air leak testing (DALT) reports with a copy(s) of the calibration curve for each of the DALT test orifices used for testing.
- c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments must have been calibrated within one year of the date of use in the field. Instrument calibration must be traceable to the measuring standards of the National Institute of Standards and Technology.
- d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.5.4.2 Certified TAB Reports

Submit: TAB Report for Season 1 in the following manner:

- a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data must be typewritten. Handwritten report forms or report data are not acceptable.
- b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:
 - (1) Measure and compile data on a continuous basis for the period in which TAB work affecting those rooms is being done.
 - (2) Measure and record data only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode.
 - (3) Data may be compiled using direct digital controls trend logging

where available. Otherwise, temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls must be fully operational a minimum of 24 hours in advance of commencing data compilation. Include the specified data in the Season I TAB Report.

- c. System Diagrams: Provide updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.
- d. Static Pressure Profiles: Report static pressure profiles for air duct systems. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. Include the following in the static pressure report data, in addition to AABC/NEBB/TABB required data:

- (1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.
- (2) Report static pressure drop across DX coils, hot water coils, installed in unit cabinetry or the system ductwork.
- (3) Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in unit cabinetry.
- (4) Report static pressure drop across air filters, acoustic silencers, moisture eliminators, air flow straighteners, air flow measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors, white sound generators, RF shielding, wave guides, security bars, blast valves, small pipes passing through ductwork, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

- (5) Report static pressure drop across outside air and relief/exhaust air louvers.
- (6) Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit, and also at the following locations:

Main Duct: Take readings at four locations along the full length of the main duct, 25 percent, 50 percent, 75 percent, and 100 percent of the total duct length.

Floor Branch Mains: Take readings at floor branch mains served by a main duct vertical riser.

Branch Main Ducts: Take readings at branch main ducts.

VAV Terminals: Take readings at inlet static pressure at VAV terminal box primary air branch ducts.

- e. Duct Traverses: Report duct traverses for main supply, return, exhaust, relief and outside air ducts. This includes all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency must evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pilot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

- f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings must provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

- g. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.
- h. Performance Curves: The TAB Supervisor must include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.
- i. Calibration Curves: The TAB Supervisor must include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturi's and flow orifices TAB'd on the job.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 WORK DESCRIPTIONS OF PARTICIPANTS

Comply with requirements of this section.

3.2 PRE-DALT/TAB MEETING

Meet with the Contracting Officer's technical representative (COTR) to develop a mutual understanding relative to the details of the DALT work and TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

3.3 DALT PROCEDURES

3.3.1 Instruments, Consumables and Personnel

Provide instruments, consumables and personnel required to accomplish the DALT field work. Follow the same basic procedure specified below for TAB Field Work, including maintenance and calibration of instruments, accuracy

of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

3.3.2 Advance Notice of Pre-Final DALT Field Work

On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing prior to the COTR's duct selection field visit.

3.3.3 Ductwork To Be DALT'd

From each duct system indicated as subject to DALT, the COTR will randomly select sections of each completed duct system for testing by the Contractor's TAB Firm. The sections selected must be no less than 25 percent of the total measured linear footage of duct systems. Sections of duct systems subject to DALT will include 20 percent of main ducts, branch main ducts, branch ducts and plenums for supply, return, exhaust, and plenum ductwork.

It is acceptable for an entire duct system to be DALT'd instead of disassembling that system in order to DALT the minimum 25 percent portion specified above.

3.3.4 DALT Testing

Perform DALT on the HVAC duct sections of each system as selected by the COTR. Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA 1972 CD.

3.3.5 Completed Pre-Final DALT Report

After completion of the DALT work, prepare a Pre-final DALT Report meeting the additional requirements specified in Appendix B REPORTS - DALT and TAB. Data required by those data report forms shall be furnished by the TAB team. Prepare the report neatly and legibly; the Pre-final DALT report shall provide the basis for the Final DALT Report.

TAB supervisor shall review, approve and sign the Pre-Final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COTR that the field check of the Pre-Final DALT Report data can commence. After completion of the DALT work, prepare a Pre-final DALT Report using the reporting forms specified. TAB team to furnish data required by those data report forms. Prepare the report neatly and legibly; the Pre-final DALT report is the basis for the Final DALT Report. TAB supervisor must review and certify the Pre-final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COTR that the field check of the Pre-final DALT Report data can commence.

3.3.6 Quality Assurance - COTR DALT Field Acceptance Testing

In the presence of the COTR and TAB team field leader, verify for accuracy Pre-final DALT Report data selected by the COTR. For each duct system, this acceptance testing shall be conducted on a maximum of 50 percent of the duct sections DALT'd.

Further, if any data on the Pre-final DALT report form for a given duct

section is out-of-tolerance, then field acceptance testing shall be conducted on data for one additional duct section, preferably in the same duct system, in the presence of the COTR.

3.3.7 Additional COTR Field Acceptance Testing

If any of the duct sections checked for a given system are determined to have a leakage rate measured that exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction class and sealant class, terminate data checking for that section. The associated Pre-final DALT Report data for the given duct system will be disapproved. Make the necessary corrections and prepare a revised Pre-final DALT Report. Reschedule a field check of the revised report data with the COTR.

3.3.8 Prerequisite for TAB Field Work

Do not commence TAB field work prior to the completion and approval, for all systems, of the Final DALT Report.

3.4 TAB PROCEDURES

3.4.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents.

Outdoor air supply systems shall be balanced to between plus 10 percent and minus zero percent of the flow rates indicated on the contract documents. Exhaust air systems shall be balanced to between plus zero percent and minus 10 percent of the flow rates indicated on the contract documents. The only water flow and air flow reporting which can be deferred until the Season 2 is that data which would be affected in terms of accuracy due to outside ambient conditions.

That is, comply with the the requirements of AABC MN-1 or SMACNA 1780 (TABB) and SMACNA 1858 (TABB), except as supplemented and modified by this section.

Provide instruments and consumables required to accomplish the TAB work. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES and NEBB MASV, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section.

3.4.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.4.3 TAB Air Distribution Systems

3.4.3.1 Units With Coils

Report heating and cooling performance capacity tests for hot water, and DX coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

- a. For air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

Do not determine entering and leaving wet and dry bulb temperatures by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

- b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.3.2 Rooftop Air Conditioning

Rooftop air conditioning systems including fans, coils, ducts, plenums, and air distribution devices for supply air, return air, and outside air.

For refrigeration compressors/condensers/condensing units/evaporators, report data as required by NEBB, AABC, and TABB standard procedures, including refrigeration operational data.

3.4.3.3 Exhaust Fans

Exhaust fan systems including fans, ducts, plenums, grilles, and hoods for exhaust air.

3.4.3.4 Cabinet Heaters

3.4.3.5 Duct Heaters

3.4.3.6 Unit Heaters

3.4.4 TAB Water Distribution Systems

3.4.4.1 Heating Hot Water

Heating hot water systems including boilers, hot water converters (e.g.,

heat exchangers), pumps, coils, system balancing valves and flow measuring devices.

3.4.5 TAB Work on Performance Tests With Seasonal Limitations

3.4.5.1 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.4.6 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within ranges indicated in TAB Field Work paragraph. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, contact the Contracting Officer for direction.

3.4.7 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph WORKMANSHIP, provide written notice, within 3 days after the deficiency is encountered to the Contractor and the Contracting Officer describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.4.8 Quality Assurance - COTR TAB Field Acceptance Testing

3.4.8.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COTR, random selections of data (water, air quantities, and air motion) recorded in the TAB Report. Points and areas for field acceptance testing are to be selected by the COTR. Measurement and test procedures are the same as approved for TAB work for the TAB Report.

Field acceptance testing includes verification of TAB Report data recorded for the following equipment groups:

Group 1: All boilers, and air handling units (rooftop and central stations).

Group 2: 25 percent of the VAV terminal boxes and associated diffusers and registers.

Group 3: 25 percent of the supply diffusers, registers, grilles

associated with constant volume air handling units.

Group 4: 25 percent of the return grilles, return registers, exhaust grilles and exhaust registers.

Group 5: 25 percent of the supply fans, exhaust fans, and pumps.

Further, if any data on the TAB Report for Groups 2 through 5 is found not to fall within the ranges indicated in TAB Field Work paragraph, additional group data verification is required in the presence of the COTR. Verify TAB Report data for one additional piece of equipment in that group. Continue this additional group data verification until out-of-tolerance data ceases to be found.

3.4.8.2 Additional COTR TAB Field Acceptance Testing

If any of the acceptance testing measurements for a given equipment group is found not to fall within the ranges indicated in TAB Field Work paragraph, terminate data verification for all affected data for that group. The affected data for the given group will be disapproved. Make the necessary corrections and prepare a revised TAB Report. Reschedule acceptance testing of the revised report data with the COTR.

3.4.8.3 Prerequisite for Approval

Compliance with the field acceptance testing requirements of this section is a prerequisite for the final Contracting Officer approval of the TAB Report submitted.

3.5 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.

3.6 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

-- End of Section --

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SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS
02/13, CHG 7: 05/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP (2013) Energy Standard for Buildings
Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A167 (2011) Standard Specification for
Stainless and Heat-Resisting
Chromium-Nickel Steel Plate, Sheet, and
Strip

ASTM A240/A240M (2020a) Standard Specification for
Chromium and Chromium-Nickel Stainless
Steel Plate, Sheet, and Strip for Pressure
Vessels and for General Applications

ASTM A580/A580M (2018) Standard Specification for
Stainless Steel Wire

ASTM B209 (2014) Standard Specification for Aluminum
and Aluminum-Alloy Sheet and Plate

ASTM C195 (2007; R 2013) Standard Specification for
Mineral Fiber Thermal Insulating Cement

ASTM C450 (2008) Standard Practice for Fabrication
of Thermal Insulating Fitting Covers for
NPS Piping, and Vessel Lagging

ASTM C534/C534M (2020a) Standard Specification for
Preformed Flexible Elastomeric Cellular
Thermal Insulation in Sheet and Tubular
Form

ASTM C547 (2019) Standard Specification for Mineral
Fiber Pipe Insulation

ASTM C552 (2017; E 2018) Standard Specification for
Cellular Glass Thermal Insulation

ASTM C553	(2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C591	(2020) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C612	(2014; R 2019) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C647	(2008; R 2013) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C755	(2019b) Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation
ASTM C795	(2008; R 2018) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C921	(2010) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C1136	(2017a) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C1290	(2016) Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C1710	(2011) Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form
ASTM D882	(2012) Tensile Properties of Thin Plastic Sheeting
ASTM D2863	(2019) Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM D3350	(2021) Polyethylene Plastics Pipe and Fittings Materials
ASTM D5590	(2000; R 2010; E 2012) Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar

Plate Assay

ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2021) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E2231	(2019) Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
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GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
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MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	(8th Ed) National Commercial & Industrial Insulation Standards
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 90B	(2021) Standard for the Installation of Warm Air Heating and Air Conditioning Systems

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage
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SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications
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TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T403 OM (2015) Bursting Strength of Paper

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-3316 (1987; Rev C; Am 2 1990) Adhesives,
Fire-Resistant, Thermal Insulation

MIL-A-24179 (1969; Rev A; Am 2 1980; Notice 1 1987;
Notice 2 2020) Adhesive, Flexible
Unicellular-Plastic Thermal Insulation

MIL-PRF-19565 (1988; Rev C) Coating Compounds, Thermal
Insulation, Fire- and Water-Resistant,
Vapor-Barrier

UNDERWRITERS LABORATORIES (UL)

UL 94 (2013; Reprint Jun 2020) UL Standard for
Safety Tests for Flammability of Plastic
Materials for Parts in Devices and
Appliances

UL 723 (2021) UL Standard for Safety Test for
Surface Burning Characteristics of
Building Materials

UL 2818 (2013) GREENGUARD Certification Program
For Chemical Emissions For Building
Materials, Finishes And Furnishings

1.2 SYSTEM DESCRIPTION

1.2.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-02 Shop Drawings

MICA Plates; G

Pipe Insulation Systems and Associated Accessories

Duct Insulation Systems and Associated Accessories

Equipment Insulation Systems and Associated Accessories

Recycled content for insulation materials; S

SD-03 Product Data

Pipe Insulation Systems; G

Duct Insulation Systems; G

Equipment Insulation Systems; G

SD-04 Samples

Thermal Insulation; G

Display Samples; G

SD-07 Certificates

Indoor air quality for adhesives; S

SD-08 Manufacturer's Instructions

Pipe Insulation Systems; G

Duct Insulation Systems; G

Equipment Insulation Systems; G

1.4 CERTIFICATIONS

1.4.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualification

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.6 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the

manufacturer and brand, and a description of the material, date codes, and approximate shelf life (if applicable). Insulation packages and containers shall be asbestos free.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit a complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section shall be submitted together in a booklet.

2.1.1 Insulation System

Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems that are located within, on, under, and adjacent to buildings; and for plumbing systems. Provide CFC and HCFC free insulation.

2.1.2 Surface Burning Characteristics

Unless otherwise specified, insulation must have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flame spread, and smoke developed indexes, shall be determined by ASTM E84 or UL 723. Test insulation in the same density and installed thickness as the material to be used in the actual construction. Prepare and mount test specimens according to ASTM E2231.

2.2 MATERIALS

Provide insulation that meets or exceeds the requirements of ASHRAE 90.1 - IP. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C795 requirements. Calcium silicate shall not be used on chilled or cold water systems. Materials shall be asbestos free. Provide product recognized under UL 94 (if containing plastic) and listed in FM APP GUIDE.

2.2.1 Adhesives

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants must meet limit

requirements of "Other" category within SCAQMD Rule 1168 sealants table). Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.2.1.1 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

2.2.1.2 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. To resist mold/mildew, lagging adhesive shall meet ASTM D5590 with 0 growth rating. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Adhesive shall be MIL-A-3316, Class 1, pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.1.3 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Flexible Elastomeric Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide product listed in FM APP GUIDE.

2.2.2 Caulking

ASTM C920, Type S, Grade NS, Class 25, Use A.

2.2.3 Corner Angles

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B209, Alloy 3003, 3105, or 5005.

2.2.4 Fittings

Fabricated Fittings are the prefabricated fittings for flexible elastomeric pipe insulation systems in accordance with ASTM C1710. Together with the flexible elastomeric tubes, they provide complete system

integrity for retarding heat gain and controlling condensation drip from chilled-water and refrigeration systems. Flexible elastomeric, fabricated fittings provide thermal protection (0.25 k) and condensation resistance (0.05 Water Vapor Transmission factor). For satisfactory performance, properly installed protective vapor retarder/barriers and vapor stops shall be used on high relative humidity and below ambient temperature applications to reduce movement of moisture through or around the insulation to the colder interior surface.

2.2.5 Finishing Cement

ASTM C450: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C795.

2.2.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive.

2.2.7 Staples

Outward clinching type ASTM A167, Type 304 or 316 stainless steel.

2.2.8 Jackets

2.2.8.1 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 by 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.2.8.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, ultraviolet (UV) resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.2.8.3 Vapor Barrier/Vapor Retarder

Apply the following criteria to determine which system is required.

- a. On ducts, piping and equipment operating below 100 degrees F or located outside shall be equipped with a vapor barrier.

- b. Ducts, pipes and equipment that are located inside and that always operate above 100 degrees F shall be installed with a vapor retarder where required as stated in paragraph VAPOR RETARDER REQUIRED.

2.2.9 Vapor Retarder Required

ASTM C921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require manufacturer or fabricator applied pipe insulation jackets are cellular glass, when all joints are sealed with a vapor barrier mastic, and mineral fiber. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible elastomerics require (in addition to vapor barrier skin) vapor retarder jacketing for high relative humidity and below ambient temperature applications.

2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

ASJ is for use on hot/cold pipes, ducts, or equipment indoors or outdoors if covered by a suitable protective jacket. The product shall meet all physical property and performance requirements of ASTM C1136, Type I, except the burst strength shall be a minimum of 85 psi. ASTM D2863 Limited Oxygen Index (LOI) shall be a minimum of 31.

In addition, neither the outer exposed surface nor the inner-most surface contacting the insulation shall be paper or other moisture-sensitive material. The outer exposed surface shall be white and have an emittance of not less than 0.80. The outer exposed surface shall be paintable.

2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

2.2.9.2.1 Vapor Barrier

The vapor barrier shall be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plies standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Permeability shall be less than 0.02 when tested in accordance with ASTM E96/E96M. Products shall meet UL 723 or ASTM E84 flame and smoke requirements and shall be UV resistant.

2.2.9.2.2 Vapor Retarder

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be in accordance with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions. The coating shall be nonflammable, fire resistant type. To resist mold/mildew, coating shall meet ASTM D5590 with 0 growth rating. Coating shall meet MIL-PRF-19565 Type II (if selected for indoor service) and be Qualified Products Database listed. All other application and service properties shall be determined pursuant to ASTM C647.

2.2.9.3 Laminated Film Vapor Retarder

ASTM C1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork; where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Vapor retarder shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible Elastomeric exterior foam with factory applied UV Jacket. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and an excellent WVT rate.

2.2.9.4 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested in accordance with ASTM D882, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.2.9.5 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for Laminated Film Vapor Retarder above.

2.2.9.6 Vapor Barrier/Weather Barrier

The vapor barrier shall be greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (less than 0.0000 permeability when tested in accordance with ASTM E96/E96M). Vapor barrier shall meet UL 723 or ASTM E84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with TAPPI T403 OM . Tensile strength 68 lb/inch width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.

2.2.10 Vapor Retarder Not Required

ASTM C921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.2.11 Wire

Soft annealed ASTM A580/A580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2.12 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge stainless steel.

2.2.13 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum permeance of 0.02 perms based on Procedure B for ASTM E96/E96M, and a maximum flame spread index of 25 and a maximum smoke

developed index of 50 when tested in accordance with ASTM E84.

2.3 PIPE INSULATION SYSTEMS

Conform insulation materials to Table 1 and minimum insulation thickness as listed in Table 2 and meet or exceed the requirements of ASHRAE 90.1 - IP. Limit pipe insulation materials to those listed herein and meeting the following requirements:

2.3.1 Recycled Materials

Provide insulation materials containing the following minimum percentage of recycled material content by weight:

- Rock Wool: 75 percent slag of weight
- Fiberglass: 20 percent glass cullet
- Rigid Foam: 9 percent recovered material
- Phenolic Rigid Foam: 9 percent recovered material

Provide data identifying percentage of recycled content for insulation materials.

2.3.2 Pier Utilities (Potable Water & Sanitary Sewer)

)Polyurethane or polyisocyanate insulation, minimum density of 1.7 pcf, rated for not less than 250 degrees F, completely filling space between carrier pipe and conduit. Provide a minimum insulation wall thickness of 1 inch.

2.3.2.1 Factory-Applied Jacket

Jacket shall be black high density polyethylene (HDPE), with a minimum thickness of 100 mils. Jacket shall be in accordance with ASTM D3350.

2.3.2.2 Factory-Applied End Seals

Provide watertight end seal, or factory lay-up type end seal between carrier pipe and conduit. Provide sufficient surface bonding area between carrier pipe and conduit to ensure permanent watertight end seal suitable for use with temperature limits of carrier pipe.

2.3.3 Aboveground Cold Pipeline (-30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

2.3.3.1 Cellular Glass

ASTM C552, Type II, and Type III. Supply the insulation from the fabricator with (paragraph WHITE VAPOR RETARDER ALL SERVICE JACKET (ASJ)) ASJ vapor retarder and installed with all longitudinal overlaps sealed and all circumferential joints ASJ taped or supply the insulation unfaced from the fabricator and install with all longitudinal and circumferential joints sealed with vapor barrier mastic.

2.3.3.2 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II. Type I,

Grade 1 for tubular materials. Type II, Grade 1, for sheet materials. Type I and II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation, and require an additional exterior vapor retarder covering for high relative humidity and below ambient temperature applications.

2.3.3.3 Polyisocyanurate Insulation

ASTM C591, Type I. Supply the insulation with a factory applied vapor retarder/barrier that complies with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation and all covering must pass the flame spread index of 25 and the smoke developed index of 50 when tested in accordance with ASTM E84.

2.3.4 Aboveground Hot Pipeline (Above 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.4.1 Mineral Fiber

ASTM C547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.4.2 Cellular Glass

ASTM C552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.4.3 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II to 220 degrees F service. Type I for tubular materials. Type II for sheet materials.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Field Applied Insulation

2.4.1.1 Rigid Insulation

Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied all-purpose jacket, 3 lb./cu.ft. density.

2.4.1.2 Blanket Insulation

Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied all-purpose jacket, 0.75 lb./cu.ft. density.

2.4.2 Acoustical Duct Lining

2.4.2.1 Duct Liner

Interior duct liner is not permitted.

2.4.3 Fire Wrap

Provide UL listed high-temperature fibrous thermal insulation blanket encapsulated in a fiberglass-reinforced aluminized foil. The blanket shall have a continuous use limit of 1800 degrees F. The Smoke development and Flame Spread index shall be 0/0.

2.4.4 Duct Insulation Jackets

2.4.4.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2.4.4.2 Metal Jackets

2.4.4.2.1 Aluminum Jackets

ASTM B209, Temper H14, minimum thickness of 27 gauge (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside dimension 8 inches and larger. Provide corrugated surface jackets for jacket outside dimension 8 inches and larger. Provide stainless steel bands, minimum width of 1/2 inch.

2.4.4.2.2 Stainless Steel Jackets

ASTM A167 or ASTM A240/A240M; Type 304, minimum thickness of 33 gauge (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2 inch.

2.4.4.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty white or natural).

2.4.5 Weatherproof Duct Insulation

Provide ASTM C552, cellular glass thermal insulation , and weatherproofing as specified in manufacturer's instruction. Multi-ply, Polymeric Blend Laminate Jacketing: Construction of laminate designed to provide UV resistance, high puncture, tear resistance and an excellent WVT rate.

2.5 EQUIPMENT INSULATION SYSTEMS

Insulate equipment and accessories as specified in Tables 5 and 6. In outside locations, provide insulation 1/2 inch thicker than specified. Increase the specified insulation thickness for equipment where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface. Submit a booklet containing manufacturer's published installation instructions for the insulation systems. The instructions must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this

solicitation. A booklet is also required by paragraphs titled: Pipe Insulation Systems and Duct Insulation Systems.

2.6 LABELS FOR PIPING AND DUCTWORK

2.6.1 Pipe Labels

- a. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- b. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- c. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- d. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

(1) Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.

(2) Lettering Size: At least 1-1/2 inches high.

2.6.2 Duct Labels

- a. Material and Thickness: Multilayer, multicolor, pre-printed labels, 1/8 inch thick.
- b. Letter Color: White.
- c. Background Color: Blue for Supply and Outside Air, Green for Return and Exhaust Air.
- d. Maximum Temperature: Able to withstand temperatures up to 160 degrees F.
- e. Minimum Label Size: Length and width vary for required label content.
- f. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- g. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

(1) Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.

(2) Lettering Size: At least 1-1/2 inches high.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Display Samples

Submit and display, after approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Contracting Officer will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

3.1.1.1 Pipe Insulation Display Sections

Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

3.1.1.2 Duct Insulation Display Sections

Display sample sections for rigid and flexible duct insulation used on the job. Use a temporary covering to enclose and protect display sections for duct insulation exposed to weather

3.1.2 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests and heat tracing specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed

in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.3 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07 84 00

FIRESTOPPING. The protection of ducts at point of passage through firewalls must be in accordance with NFPA 90A and/or NFPA 90B. All other penetrations, such as piping, conduit, and wiring, through firewalls must be protected with a material or system of the same hourly rating that is listed by UL, FM, or a NRTL.

3.1.4 Painting and Finishing

Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.1.5 Installation of Flexible Elastomeric Cellular Insulation

Install flexible elastomeric cellular insulation with seams and joints sealed with rubberized contact adhesive. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 220 degrees F. Stagger seams when applying multiple layers of insulation. Protect insulation exposed to weather and not shown to have vapor barrier weatherproof jacketing with two coats of UV resistant finish or PVC or metal jacketing as recommended by the manufacturer after the adhesive is dry and cured.

3.1.5.1 Adhesive Application

Apply a brush coating of adhesive to both butt ends to be joined and to both slit surfaces to be sealed. Allow the adhesive to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.5.2 Adhesive Safety Precautions

Use natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

3.1.6 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.7 Pipes/Ducts/Equipment That Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items as specified.

3.1.8 Insulation Labeling

Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts and plenums; and exterior exposed locations as follows:

- (1) Near each valve and control device.
- (2) Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
- (3) Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
- (4) At access doors, manholes, and similar access points that permit view of concealed piping.
- (5) Near major equipment items and other points of origination and termination.
- (6) Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
- (7) Locate duct labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet.

3.2 PIPE INSULATION SYSTEMS INSTALLATION

Install pipe insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.
- c. Sanitary drain lines.
- d. Air chambers.
- e. Adjacent insulation.
- f. ASME stamps.

g. Access plates of fan housings.

h. Cleanouts or handholes.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

Pipe insulation shall be continuous through the sleeve.

Provide an aluminum jacket or vapor barrier/weatherproofing self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed with factory applied moisture retarder over the insulation wherever penetrations require sealing.

3.2.1.2.1 Penetrate Interior Walls

The aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 plies standard grade, silver, white, black and embossed shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

3.2.1.2.2 Penetrating Floors

Extend the aluminum jacket from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

3.2.1.2.3 Penetrating Waterproofed Floors

Extend the aluminum jacket from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

3.2.1.2.4 Penetrating Exterior Walls

Continue the aluminum jacket required for pipe exposed to weather through the sleeve to a point 2 inches beyond the interior surface of the wall.

3.2.1.2.5 Penetrating Roofs

Insulate pipe as required for interior service to a point flush with the top of the flashing and sealed with flashing sealant. Tightly butt the insulation for exterior application to the top of flashing and interior insulation. Extend the exterior aluminum jacket 2 inches down beyond the end of the insulation to form a counter flashing. Seal the flashing and counter flashing underneath with metal jacketing/flashing sealant.

3.2.1.2.6 Hot Water Pipes Supplying Lavatories or Other Similar Heated Service

Terminate the insulation on the backside of the finished wall. Protect the insulation termination with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). Extend the coating out onto the insulation 2 inches and seal the end of the insulation. Overlap glass tape seams 1 inch. Caulk the annular space between the pipe and wall penetration with approved fire stop material. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate

shall overlap the wall penetration at least 3/8 inches.

3.2.1.2.7 Domestic Cold Water Pipes Supplying Lavatories or Other Similar Cooling Service

Terminate the insulation on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). Protect the insulation with two coats of weather barrier mastic (breather emulsion type weatherproof mastic impermeable to water and permeable to air) with a minimum total thickness of 1/16 inch. Extend the mastic out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and caulk the wall penetration with an approved fire stop material having vapor retarder properties. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.

3.2.1.3 Pipes Passing Through Hangers

Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-58. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed, or factory insulated hangers (designed with a load bearing core) can be used.

3.2.1.3.1 Horizontal Pipes Larger Than 2 Inches at 60 Degrees F and Above

Supported on hangers in accordance with MSS SP-58, and Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2.1.3.2 Horizontal Pipes Larger Than 2 Inches and Below 60 Degrees F

Supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-58. An insulation insert of cellular glass, prefabricated insulation pipe hangers, or perlite above 80 degrees F shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

3.2.1.3.3 Vertical Pipes

Supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-58 covering the 360-degree arc of the insulation. An insulation insert of cellular glass shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield

to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

3.2.1.3.4 Inserts

Covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, overlap the adjoining pipe jacket 1-1/2 inches, and seal as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Grade 1, Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation. Type II requires an additional exterior vapor retarder/barrier covering for high relative humidity and below ambient temperature applications.

3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, welded PVC, or aluminum jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

3.2.1.6 Pipe Insulation Material and Thickness

Pipe insulation materials must be as listed in Table 1 and must meet or exceed the requirements of ASHRAE 90.1 - IP.

TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd
Heating Hot Water Supply & Return (Max 250 F)					
	Mineral Fiber	ASTM C547	I	1	No
	Cellular Glass	ASTM C552	II	2	No

TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping					
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)					
	Mineral Fiber	ASTM C547	I	1	No
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Refrigerant Suction Piping (35 degrees F nominal)					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Condensate Drain Located Inside Building					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No

TABLE 2						
Piping Insulation Thickness (inch) Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.						
Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
Heating Hot Water Supply & Return (Max 250 F)						
	Mineral Fiber	1.5	1.5	2	2	2
	Cellular Glass	2	2.5	3	3	3
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping						
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)						
	Mineral Fiber	1	1	1	1.5	1.5
	Cellular Glass	1.5	1.5	1.5	2	2
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Refrigerant Suction Piping (35 degrees F nominal)						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel						
	Flexible Elastomeric Cellular	0.5	0.5	0.5	0.5	0.5
Condensate Drain Located Inside Building						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Polyurethane	1	1	1	1	1

3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

- a. Make-up water.

- b. Refrigerant suction lines.
- c. Air conditioner condensate drains.
- d. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.
- e. Domestic cold and chilled drinking water.

3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

3.2.2.2 Factory or Field applied Jacket

Insulation shall be covered with a factory applied vapor retarder jacket/vapor barrier or field applied seal welded PVC jacket or greater than 3 ply laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, standard grade, silver, white, black and embossed for use with Mineral Fiber, Cellular Glass, and Phenolic Foam Insulated Pipe. Insulation inside the building, to be protected with greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, Embossed Silver, White & Black, shall have the insulation and vapor retarder jacket installed as specified herein.

3.2.2.3 Installing Insulation for Straight Runs Hot and Cold Pipe

Apply insulation to the pipe with tight butt joints. Seal all butted joints and ends with joint sealant and seal with a vapor retarder coating, greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or PVDC adhesive tape.

3.2.2.3.1 Longitudinal Laps of the Jacket Material

Overlap not less than 1-1/2 inches. Provide butt strips 3 inches wide for circumferential joints.

3.2.2.3.2 Laps and Butt Strips

Secure with adhesive and staple on 4 inch centers if not factory self-sealing. If staples are used, seal in accordance with paragraph STAPLES below. Note that staples are not required with cellular glass systems.

3.2.2.3.3 Factory Self-Sealing Lap Systems

May be used when the ambient temperature is between 40 and 120 degrees F during installation. Install the lap system in accordance with manufacturer's recommendations. Use a stapler only if specifically recommended by the manufacturer. Where gaps occur, replace the section or repair the gap by applying adhesive under the lap and then stapling.

3.2.2.3.4 Staples

Coat all staples, including those used to repair factory self-seal lap systems, with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - 0.0000 perm adhesive tape. Coat all seams,

except those on factory self-seal systems, with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.5 Breaks and Punctures in the Jacket Material

Patch by wrapping a strip of jacket material around the pipe and secure it with adhesive, staple, and coat with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. Extend the patch not less than 1-1/2 inches past the break.

3.2.2.3.6 Penetrations Such as Thermometers

Fill the voids in the insulation and seal with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.7 Flexible Elastomeric Cellular Pipe Insulation

Install by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. Secure all seams and butt joints and seal with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Push insulation on the pipe, never pulled. Stretching of insulation may result in open seams and joints. Clean cut all edges. Rough or jagged edges of the insulation are not be permitted. Use proper tools such as sharp knives. Do not stretch Grade 1, Type II sheet insulation around the pipe when used on pipe larger than 6 inches. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.2.4 Insulation for Fittings and Accessories

- a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.
- b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow". Submit a booklet containing completed MICA Insulation Stds plates detailing each insulating system for each pipe, duct, or equipment insulating system, after approval of materials and prior to applying insulation.
 - (1) The MICA plates shall detail the materials to be installed and the specific insulation application. Submit all MICA plates required showing the entire insulating system, including plates

required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. The MICA plates shall present all variations of insulation systems including locations, materials, vaporproofing, jackets and insulation accessories.

(2) If the Contractor elects to submit detailed drawings instead of edited MICA Plates, the detail drawings shall be technically equivalent to the edited MICA Plate submittal.

- c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with either greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape, standard grade, silver, white, black and embossed or PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.
- d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.
- e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Aboveground Hot Pipelines

3.2.3.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

- a. Domestic hot water supply & re-circulating system.

b. Heating hot water.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

3.2.3.2 Insulation for Fittings and Accessories

Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant. Insulation shall be marked showing the location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation.

3.2.3.2.1 Precut or Preformed

Place precut or preformed insulation around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

3.2.3.2.2 Rigid Preformed

Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket, stainless steel or PVC jacket shall be applied.

PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION in PART 3.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with metal jacketing/flashing sealant while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed, and UV resistant).

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.2.4.4 Stainless Steel Jackets

ASTM A167 or ASTM A240/A240M; Type 304, minimum thickness of 33 gauge (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2 inch.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

3.3.1 Duct Insulation Minimum Thickness

Duct insulation minimum thickness in accordance with Table 4.

Table 4 - Minimum Duct Insulation (inches)	
Supply Air Ducts	2.0
Return Ducts	1.5
Outside and Combustion Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment.

- a. Supply ducts.
- b. Return air ducts.

- c. Relief ducts.
- d. Flexible run-outs (field-insulated).
- e. Plenums.
- f. Outside air intake ducts.
- g. Supply fans (field-insulated).
- h. Ducts exposed to weather.
- i. Combustion air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for both concealed or exposed round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation for all exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified, the total field applied dry film thickness shall be approximately 1/16 inch. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

3.3.2.1 Installation on Concealed Duct

- a. For rectangular, oval or round ducts, flexible insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.
- b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.
- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.
- d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

- e. Where mechanical fasteners are used, self-locking washers shall be installed and the pin trimmed and bent over.
- f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.
- g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.
- h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.
- i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

- a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches. Mechanical fasteners shall be as corrosion resistant as G60 coated galvanized steel, and shall indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall.
- b. Form duct insulation with minimum jacket seams. Fasten each piece of rigid insulation to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder/barrier jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.
- c. Impale insulation on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.

- d. Seal joints in the insulation jacket with a 4 inch wide strip of tape. Seal taped seams with a brush coat of vapor retarder coating.
- e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.
- f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a flashing sealant.
- g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as in accordance with MICA standards.

3.3.3 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.4 Fire Wrap

Install fire wrap in accordance with manufacturer's recommendation. Install layers required to provide indicated fire rating.

3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

- a. Hand-holes.
- b. Boiler manholes.
- c. Cleanouts.
- d. ASME stamps.
- e. Manufacturer's nameplates.
- f. Duct Test/Balance Test Holes.

3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

- a. Pumps.
- b. Refrigeration equipment parts that are not factory insulated.
- c. Drip pans under chilled equipment.
- d. Cold water storage tanks.
- e. Water softeners.
- f. Duct mounted coils.
- g. Cold and chilled water pumps.
- h. Air handling equipment parts that are not factory insulated.
- i. Expansion and air separation tanks.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Material and thicknesses shall be as shown in Table 5:

TABLE 5		
Insulation Thickness for Cold Equipment (inches)		
Equipment handling media at indicated temperature		
	Material	Thickness (inches)
35 to 60 degrees F		
	Cellular Glass	1.5
	Flexible Elastomeric Cellular	1
1 to 34 degrees F		
	Cellular Glass	3
	Flexible Elastomeric Cellular	1.5
Minus 30 to 0 degrees F		
	Cellular Glass	3.5
	Flexible Elastomeric Cellular	1.75

3.4.2.2 Pump Insulation

- a. Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.
- b. Exposed insulation corners shall be protected with corner angles.
- c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Flashing sealant shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

- a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.
- b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12 inch centers except flexible elastomeric cellular which shall be adhered with contact adhesive. Insulation corners shall be protected under wires and bands with suitable corner angles.
- c. Cellular glass shall be installed in accordance with manufacturer's instructions. Joints and ends shall be sealed with joint sealant, and sealed with a vapor retarder coating.
- d. Insulation on heads of heat exchangers shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch.
- e. Exposed insulation corners shall be protected with corner angles.
- f. Insulation on equipment with ribs shall be applied over 6 by 6 inches by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inches washers or shall be securely banded or wired in place on 12 inch centers.

3.4.2.4 Vapor Retarder/Vapor Barrier

Upon completion of installation of insulation, penetrations shall be

caulked. Two coats of vapor retarder coating or vapor barrier jacket shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Flashing sealant or vapor barrier tape shall be applied to parting line between equipment and removable section insulation.

3.4.3 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 60 degrees F including the following:

- a. Water heaters.
- b. Pumps handling media above 130 degrees F.
- c. Air separation tanks.
- d. Unjacketed boilers or parts of boilers.
- e. Boiler flue gas connection from boiler to stack (if inside).
- f. Induced draft fans.

3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered.

Insulation thickness for hot equipment shall be determined using Table 6:

TABLE 6		
Insulation Thickness for Hot Equipment (inches)		
Equipment handling steam or media at indicated pressure or temperature limit		
	Material	Thickness (inches)
250 degrees F		
	Rigid Mineral Fiber	2
	Flexible Mineral Fiber	2
	Calcium Silicate/Perlite	4
	Cellular Glass	3
	Faced Phenolic Foam	1.5
	Flexible Elastomeric Cellular (<200 F)	1

TABLE 6		
Insulation Thickness for Hot Equipment (inches)		
Equipment handling steam or media at indicated pressure or temperature limit		
	Material	Thickness (inches)

3.4.3.2 Insulation of Pumps

Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing that does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line of the removable sections and penetrations.

3.4.3.3 Other Equipment

- Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.
- Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 12 inch centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with

suitable corner angles.

- c. On high vibration equipment, cellular glass insulation shall be set in a coating of bedding compound as recommended by the manufacturer, and joints shall be sealed with bedding compound. Mineral fiber joints shall be filled with finishing cement.
- d. Insulation on heads of heat exchangers shall be removable. The removable section joint shall be fabricated using a male-female shiplap type joint. Entire surface of the removable section shall be finished as specified.
- e. Exposed insulation corners shall be protected with corner angles.
- f. On equipment with ribs, such as boiler flue gas connection, draft fans, and fly ash or soot collectors, insulation shall be applied over 6 by 6 inch by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inch washers or shall be securely banded or wired in place on 12 inch (maximum) centers.
- g. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.4 Equipment Handling Dual Temperature Media

Below and above 60 degrees F: equipment handling dual temperature media shall be insulated as specified for cold equipment.

3.4.5 Equipment Exposed to Weather

3.4.5.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

-- End of Section --

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SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

02/19, CHG 2: 02/20

PART 1 GENERAL

1.1 SUMMARY

Provide a complete Direct Digital Control (DDC) system, except for the Front End which is specified in Section 25 05 11.01 CYBERSECURITY FOR BUILDING AUTOMATION SYSTEM, suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as indicated and shown and in accordance with Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 93 SEQUENCES OF OPERATION FOR HVAC CONTROL, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet or Niagara BACnet systems, and other referenced Sections.

1.1.1 Proprietary Systems

1.1.1.1 Proprietary Systems Exempted From Open Protocol Requirements

The following systems are specifically exempted from the open protocol requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS:

- a. A simple split (DX) system consisting of a single indoor unit and a single outdoor unit from the same manufacturer.

1.1.1.2 Implementation of Proprietary Systems

For proprietary systems exempted from open protocol requirements, a proprietary network and DDC hardware communicating via proprietary protocol are permitted. For these systems a building control network meeting the requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS must also be provided, along with a gateway or interface to connect the proprietary system to the open building control network.

The proprietary system gateway or interface must provide the required functionality as shown on the points schedule. Scheduling, alarming, trending, overrides, network inputs, network outputs and other protocol related requirements must be met on the open protocol control system as specified in Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

1.1.1.3 Proprietary Multi-Split Engineering Tool Software

For each permitted proprietary systems in Table 1 shown as requiring Proprietary Multi-Split Engineering Tool Software, provide the software needed to replace a unit and configure the replacement. Submit hard copies of the software user manuals with the software submittal.

Submit Proprietary Multi-Split Engineering Tool Software on CD-ROM as a Technical Data Package. Submit 1 hard copies of the software user manual for each piece of software.

1.1.2 System Requirements

Provide systems meeting the requirements this Section and other Sections referenced by this Section, and which have the following characteristics:

- a. The system implements the control sequences of operation shown in the Contract Drawings using DDC hardware to control mechanical and electrical equipment
- b. The system meet the requirements of this specification as a stand-alone system and does not require connection to any other system.
- c. Control sequences reside in DDC hardware in the building. The building control network is not dependent upon connection to a Utility Monitoring and Control System (UMCS) Front End or to any other system for performance of control sequences. To the greatest extent practical, the hardware performs control sequences without reliance on the building network.
- d. The hardware is installed such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.
- e. All necessary documentation, configuration information, programming tools, programs, drivers, and other software are licensed to and otherwise remain with the Government such that the Government or their agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor, Vendor or Manufacturer.
- f. Sufficient documentation and data, including rights to documentation and data, are provided such that the Government or their agents can execute work to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor, Vendor or Manufacturer.
- g. Hardware is installed and configured such that the Government or their agents are able to perform repair, replacement, and upgrades of individual hardware without further interaction with the Contractor, Vendor or Manufacturer.

1.1.3 End to End Accuracy

Select products, install and configure the system such that the maximum error of a measured value as read from the DDC Hardware over the network is less than the maximum allowable error specified for the sensor or instrumentation.

1.1.4 Verification of Dimensions

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.1.5 Drawings

The Government will not indicate all offsets, fittings, and accessories that may be required on the drawings. Carefully investigate the

mechanical, electrical, and finish conditions that could affect the work to be performed, arrange such work accordingly, and provide all work necessary to meet such conditions.

1.2 RELATED SECTIONS

Related work specified elsewhere:

- a. Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet systems with or without Niagara Framework.
- b. Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
- c. Section 23 09 93 SEQUENCES OF OPERATIONS FOR HVAC CONTROLS
- d. Section 25 05 11.01 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS
- e. Section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 135 (2016) BACnet-A Data Communication Protocol for Building Automation and Control Networks

ASHRAE FUN IP (2017) Fundamentals Handbook, I-P Edition

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2018) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

NFPA 90A (2021) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 5085-3 (2006; Reprint Nov 20121) Low Voltage

Transformers - Part 3: Class 2 and Class 3
Transformers

1.4 DEFINITIONS

The following list of definitions includes terms used in Sections referenced by this Section and are included here for completeness. The definitions contained in this Section may disagree with how terms are defined or used in other documents, including documents referenced by this Section. The definitions included here are the authoritative definitions for this Section and all Sections referenced by this Section.

After each term the protocol related to that term is included in parenthesis.

1.4.1 Alarm Generation (All protocols)

Alarm Generation is the monitoring of a value, comparison of the value to alarm conditions and the creation of an alarm when the conditions set for the alarm are met. Note that this does NOT include delivery of the alarm to the final destination (such as a user interface) - see paragraph ALARM ROUTING in Section 25 05 11.01 CYBERSECURITY FOR BUILDING AUTOMATION SYSTEM.

1.4.2 Building Automation and Control Network (BACnet) (BACnet)

The term BACnet is used in two ways. First meaning the BACnet Protocol Standard - the communication requirements as defined by ASHRAE 135 including all annexes and addenda. The second to refer to the overall technology related to the ASHRAE 135 protocol.

1.4.3 BACnet Advanced Application Controller (B-AAC) (BACnet)

A hardware device BTL Listed as a B-AAC, which is required to support BACnet Interoperability Building Blocks (BIBBs) for scheduling and alarming, but is not required to support as many BIBBs as a B-BC.

1.4.4 BACnet Application Specific Controller (B-ASC) (BACnet)

A hardware device BTL Listed as a B-ASC, with fewer BIBB requirements than a B-AAC. It is intended for use in a specific application.

1.4.5 BACnet Building Controller (B-BC) (BACnet)

A hardware device BTL Listed as a B-BC. A general-purpose, field-programmable device capable of carrying out a variety of building automation and control tasks including control and monitoring via direct digital control (DDC) of specific systems and data storage for trend information, time schedules, and alarm data. Like the other BTL Listed controller types (B-AAC, B-ASC etc.) a B-BC device is required to support the server ("B") side of the ReadProperty and WriteProperty services, but unlike the other controller types it is also required to support the client ("A") side of these services. Communication between controllers requires that one of them support the client side and the other support the server side, so a B-BC is often used when communication between controllers is needed.

1.4.6 BACnet Broadcast Management Device (BBMD) (BACnet)

A communications device, typically combined with a BACnet router. A BBMD

forwards BACnet broadcast messages to BACnet/IP devices and other BBMDs connected to the same BACnet/IP network. Each IP subnet that is part of a BACnet/IP network must have at least one BBMD. Note there are additional restrictions when multiple BBMDs share an IP subnet.

1.4.7 BACnet/IP (BACnet)

An extension of BACnet, Annex J, defines the use of a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnets that share the same BACnet network number. See also paragraph BACNET BROADCAST MANAGEMENT DEVICE.

1.4.8 BACnet Internetwork (BACnet)

Two or more BACnet networks, connected with BACnet routers. In a BACnet Internetwork, there exists only one message path between devices.

1.4.9 BACnet Interoperability Building Blocks (BIBBs) (BACnet)

A BIBB is a collection of one or more ASHRAE 135 Services intended to define a higher level of interoperability. BIBBs are combined to build the BACnet functional requirements for a device in a specification. Some BIBBs define additional requirements (beyond requiring support for specific services) in order to achieve a level of interoperability. For example, the BIBB DS-V-A (Data Sharing-View-A), which would typically be used by a front-end, not only requires the client to support the ReadProperty Service, but also provides a list of data types (Object / Properties) which the client must be able to interpret and display for the user.

In the BIBB shorthand notation, -A is the client side and -B is the server side.

The following is a list of some BIBBs used by this or referenced Sections:	
DS-COV-A	Data Sharing-Change of Value (A side)
DS-COV-B	Data Sharing-Change of Value (B side)
NM-RC-B	Network Management-Router Configuration (B side)
DS-RP-A	Data Sharing-Read Property (A side)
DS-RP-B	Data Sharing-Read Property (B side)
DS-RPM-A	Data Sharing-Read Property Multiple (A Side)
DS-RPM-B	Data Sharing-Read Property Multiple (B Side)
DS-WP-A	Data Sharing-Write Property (A Side)
DM-TS-B	Device Management-Time Synchronization (B Side)
DM-UTC-B	Device Management-UTC Time Synchronization (B Side)

The following is a list of some BIBBs used by this or referenced Sections:	
DS-WP-B	Data Sharing-Write Property (B side)
SCHED-E-B	Scheduling-External (B side)
DM-OCD-B	Device Management-Object Creation and Deletion (B side)
AE-N-I-B	Alarm and Event-Notification Internal (B Side)
AE-N-E-B	Alarm and Event-Notification External (B Side)
T-VMT-I-B	Trending-Viewing and Modifying Trends Internal (B Side)
T-VMT-E-B	Trending-Viewing and Modifying Trends External (B Side)

1.4.10 BACnet Network (BACnet)

In BACnet, a portion of the control Internetwork consisting of one or more segments connected by repeaters. Networks are separated by routers.

1.4.11 BACnet Operator Display (B-OD) (BACnet)

A basic operator interface with limited capabilities relative to a B-OWS. It is not intended to perform direct digital control. A B-OD profile could be used for LCD devices, displays affixed to BACnet devices, handheld terminals or other very simple user interfaces.

1.4.12 BACnet Segment (BACnet)

One or more physical segments interconnected by repeaters (ASHRAE 135).

1.4.13 BACnet Smart Actuator (B-SA) (BACnet)

A simple actuator device with limited resources intended for specific applications.

1.4.14 BACnet Smart Sensor (B-SS) (BACnet)

A simple sensing device with limited resources.

1.4.15 BACnet Testing Laboratories (BTL) (BACnet)

Established by BACnet International to support compliance testing and interoperability testing activities and consists of BTL Manager and the BTL Working Group (BTL-WG). BTL also publishes Implementation Guidelines.

1.4.16 BACnet Testing Laboratories (BTL) Listed (BACnet)

A device that has been listed by BACnet Testing Laboratory. Devices may be certified to a specific device profile, in which case the listing indicates that the device supports the required capabilities for that profile, or may be listed as "other".

1.4.17 Binary (All protocols)

A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level. 'Digital' is sometimes used interchangeably with 'binary'.

1.4.18 Broadcast (BACnet)

Unlike most messages, which are intended for a specific recipient device, a broadcast message is intended for all devices on the network.

1.4.19 Building Control Network (BCN) (All protocols)

The network connecting all DDC Hardware within a building (or specific group of buildings).

1.4.20 Building Point of Connection (BPOC) (All protocols)

A FPOC for a Building Control System. (This term is being phased out of use in preference for FPOC but is still used in some specifications and criteria. When it was used, it typically referred to a piece of control hardware. The current FPOC definition typically refers instead to IT hardware.)

1.4.21 Commandable (All protocols)

See Overridable.

1.4.22 Commandable Objects (BACnet)

Commandable Objects have a Commandable Property, Priority_Array, and Relinquish_Default Property as defined in ASHRAE 135, Clause 19.2, Command Prioritization.

1.4.23 Configurable (All protocols)

A property, setting, or value is configurable if it can be changed via hardware settings on the device, via the use of engineering software or over the control network from the front end, and is retained through (after) loss of power.

In a BACnet system, a property, setting, or value is configurable if it can be changed via one or more of:

- 1) via BACnet services (including proprietary BACnet services)
- 2) via hardware settings on the device

Note this is more stringent than the ASHRAE 135 definition.

1.4.24 Control Logic Diagram (All protocols)

A graphical representation of control logic for multiple processes that make up a system.

1.4.25 Device (BACnet)

A Digital Controller that contains a BACnet Device Object and uses BACnet to communicate with other devices.

1.4.26 Device Object (BACnet)

Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object requires a unique Object Identifier number on the BACnet Internetwork. This number is often referred to as the device instance or device ID.

1.4.27 Device Profile (BACnet)

A collection of BIBBs determining minimum BACnet capabilities of a device, defined in ASHRAE 135. Standard device profiles include BACnet Advanced Workstations (B-AWS), BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS).

1.4.28 Digital Controller (All protocols)

An electronic controller, usually with internal programming logic and digital and analog input/output capability, which performs control functions.

1.4.29 Direct Digital Control (DDC) (All protocols)

Digital controllers performing control logic. Usually the controller directly senses physical values, makes control decisions with internal programs, and outputs control signals to directly operate switches, valves, dampers, and motor controllers.

1.4.30 Field Point of Connection (FPOC) (All protocols)

The FPOC is the point of connection between the UMCS IP Network and the field control network (either an IP network, a non-IP network, or a combination of both). The hardware at this location which provides the connection is generally an IT device such as a switch, IP router, or firewall.

In general, the term "FPOC Location" means the place where this connection occurs, and "FPOC Hardware" means the device that provides the connection. Sometimes the term "FPOC" is used to mean either and its actual meaning (i.e. location or hardware) is determined by the context in which it is used.

1.4.31 Gateway (All protocols)

A device that translates from one protocol application data format to another. Devices that change only the transport mechanism of the protocol - "translating" from TP/FT-10 to Ethernet/IP or from BACnet MS/TP to BACnet over IP for example - are not gateways as the underlying data format does not change. Gateways are also called Communications Bridges or Protocol Translators.

1.4.32 IEEE 802.3 Ethernet (All protocols)

A family of local-area-network technologies providing high-speed networking features over various media, typically Cat 5, 5e or Cat 6 twisted pair copper or fiber optic cable.

1.4.33 Internet Protocol (IP, TCP/IP, UDP/IP) (All protocols)

A communication method, the most common use is the World Wide Web. At the lowest level, it is based on Internet Protocol (IP), a method for conveying and routing packets of information over various LAN media. Two common protocols using IP are User Datagram Protocol (UDP) and Transmission Control Protocol (TCP). UDP conveys information to well-known "sockets" without confirmation of receipt. TCP establishes connections, also known as "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

1.4.34 Input/Output (I/O) (All protocols)

Physical inputs and outputs to and from a device, although the term sometimes describes network or "virtual" inputs or outputs. See also "Points".

1.4.35 I/O Expansion Unit (All protocols)

An I/O expansion unit provides additional point capacity to a digital controller

1.4.36 IP subnet (All protocols)

A group of devices which share a defined range IP addresses. Devices on a common IP subnet can share data (including broadcasts) directly without the need for the traffic to traverse an IP router.

1.4.37 Local-Area Network (LAN) (All protocols)

A communication network that spans a limited geographic area and uses the same basic communication technology throughout.

1.4.38 Local Display Panels (LDPs) (All protocols)

A DDC Hardware with a display and navigation buttons, and must provide display and adjustment of points as shown on the Points Schedule and as indicated.

1.4.39 MAC Address (All protocols)

Media Access Control address. The physical device address that identifies a device on a Local Area Network.

1.4.40 Master-Slave/Token-Passing (MS/TP) (BACnet)

Data link protocol as defined by the BACnet standard. Multiple speeds (data rates) are permitted by the BACnet MS/TP standard.

1.4.41 Monitoring and Control (M&C) Software (All protocols)

The UMCS 'front end' software which performs supervisory functions such as alarm handling, scheduling and data logging and provides a user interface for monitoring the system and configuring these functions.

1.4.42 Network Number (BACnet)

A site-specific number assigned to each network. This network number must be unique throughout the BACnet Internetwork.

1.4.43 Object (BACnet)

An ASHRAE 135 Object. The concept of organizing BACnet information into standard components with various associated Properties. Examples include Analog Input objects and Binary Output objects.

1.4.44 Object Identifier (BACnet)

A grouping of two Object properties: Object Type (e.g. Analog Value, Schedule, etc.) and Object Instance (in this case, a number). Object Identifiers must be unique within a device.

1.4.45 Object Instance (BACnet)

See paragraph OBJECT IDENTIFIER

1.4.46 Object Properties (BACnet)

Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.

1.4.47 Operator Configurable (All protocols)

Operator configurable values are values that can be changed from a single common front end user interface across multiple vendor systems.

For non Niagara-based BACnet systems, a property, setting, or value in a device is Operator Configurable when it is Configurable and is either:

- a. a Writable Property of a Standard BACnet Object; or
- b. a Property of a Standard BACnet Object that is Writable when Out_Of_Service is TRUE and Out_Of_Service is Writable.

1.4.48 Override (All protocols)

Changing the value of a point outside of the normal sequence of operation where the change has priority over the sequence and where there is a mechanism for releasing the change such that the point returns to the normal value. Overrides persist until released or overridden at the same or higher priority but are not required to persist through a loss of power. Overrides are often used by operators to change values, and generally originate at a user interface (workstation or local display panel).

1.4.49 Packaged Equipment (All protocols)

Packaged equipment is a single piece of equipment provided by a manufacturer in a substantially complete and operable condition, where the controls (DDC Hardware) are factory installed, and the equipment is sold and shipped from the manufacturer as a single entity. Disassembly and reassembly of a large piece of equipment for shipping does not prevent it from being packaged equipment. Package units may require field installation of remote sensors. Packaged equipment is also called a "packaged unit".

Note industry may use the term "Packaged System" to mean a collection of

equipment that is designed to work together where each piece of equipment is packaged equipment and there is a network that connects the equipment together. A "packaged system" of this type is NOT packaged equipment; it is a collection of packaged equipment, and each piece of equipment must individually meet specification requirements.

1.4.50 Packaged Unit (All protocols)

See packaged equipment.

1.4.51 Performance Verification Test (PVT) (All protocols)

The procedure for determining if the installed BAS meets design criteria prior to final acceptance. The PVT is performed after installation, testing, and balancing of mechanical systems. Typically the PVT is performed by the Contractor in the presence of the Government.

1.4.52 Physical Segment (BACnet)

A single contiguous medium to which BACnet devices are attached (ASHRAE 135).

1.4.53 Polling (All protocols)

A device periodically requesting data from another device.

1.4.54 Points (All protocols)

Physical and virtual inputs and outputs. See also paragraph INPUT/OUTPUT (I/O).

1.4.55 Proportional, Integral, and Derivative (PID) Control Loop (All protocols)

Three parameters used to control modulating equipment to maintain a setpoint. Derivative control is often not required for HVAC systems (leaving "PI" control).

1.4.56 Proprietary (BACnet)

Within the context of BACnet, any extension of or addition to object types, properties, PrivateTransfer services, or enumerations specified in ASHRAE 135. Objects with Object_Type values of 128 and above are Proprietary Objects. Properties with Property_Identifier of 512 and above are proprietary Properties.

1.4.57 Protocol Implementation Conformance Statement (PICS) (BACnet)

A document, created by the manufacturer of a device, which describes which portions of the BACnet standard may be implemented by a given device. ASHRAE 135 requires that all ASHRAE 135 devices have a PICS, and also defines a minimum set of information that must be in it. A device as installed for a specific project may not implement everything in its PICS.

1.4.58 Repeater (All protocols)

A device that connects two control network segments and retransmits all information received on one side onto the other.

1.4.59 Router (All protocols)

A device that connects two ASHRAE 135 networks and controls traffic between the two by retransmitting signals received from one side onto the other based on the signal destination. Routers are used to subdivide a BACnet internetwork and to limit network traffic.

1.4.60 Segment (All protocols)

A 'single' section of a control network that contains no repeaters or routers. There is generally a limit on the number of devices on a segment, and this limit is dependent on the topology/media and device type.

1.4.61 Standard BACnet Objects (BACnet)

Objects with Object_Type values below 128 and specifically enumerated in Clause 21 of ASHRAE 135. Objects which are not proprietary. See paragraph PROPRIETARY.

1.4.62 Standard BACnet Properties (BACnet)

Properties with Property_Identifier values below 512 and specifically enumerated in Clause 21 of ASHRAE 135. Properties which are not proprietary. See Proprietary.

1.4.63 Standard BACnet Services (BACnet)

ASHRAE 135 services other than ConfirmedPrivateTransfer or UnconfirmedPrivateTransfer. See paragraph PROPRIETARY.

1.4.64 UMCS (All protocols)

UMCS stands for Utility Monitoring and Control System. The term refers to all components by which a project site monitors, manages, and controls real-time operation of HVAC and other building systems. These components include the UMCS "front-end" and all field building control systems connected to the front-end. The front-end consists of Monitoring and Control Software (user interface software), browser-based user interfaces and network infrastructure.

The network infrastructure (the "UMCS Network"), is an IP network connecting multiple building or facility control networks to the Monitoring and Control Software.

1.4.65 UMCS Network (All protocols)

The UMCS Network connects multiple building or facility control networks to the Monitoring and Control Software.

1.4.66 Writable Property (BACnet)

A Property is Writable when it can be changed through the use of one or more of the WriteProperty services defined in ASHRAE 135, Clause 15 regardless of the value of any other Property. Note that in the ASHRAE 135 standard, some Properties may be writable when the Out of Service Property is TRUE; for purposes of this Section, Properties that are only writable when the Out of Service Property is TRUE are not considered to be Writable.

1.5 PROJECT SEQUENCING

TABLE II: PROJECT SEQUENCING lists the sequencing of submittals as specified in paragraph SUBMITTALS (denoted by an 'S' in the 'TYPE' column) and activities as specified in PART 3 EXECUTION (denoted by an 'E' in the 'TYPE' column). TABLE II does not specify overall project milestone and completion dates.

- a. Sequencing for Submittals: The sequencing specified for submittals is the deadline by which the submittal must be initially submitted to the Government. Following submission there will be a Government review period as specified in Section 01 33 00 SUBMITTAL PROCEDURES. If the submittal is not accepted by the Government, revise the submittal and resubmit it to the Government within 14 days of notification that the submittal has been rejected. Upon resubmittal there will be an additional Government review period. If the submittal is not accepted the process repeats until the submittal is accepted by the Government.
- b. Sequencing for Activities: The sequencing specified for activities indicates the earliest the activity may begin.
- c. Abbreviations: In TABLE II the abbreviation AAO is used for 'after approval of' and 'ACO' is used for 'after completion of'.

TABLE II. PROJECT SEQUENCING			
ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL)
2	S	DDC Contractor Design Drawings	
3	S	Manufacturer's Product Data	
4	S	Pre-construction QC Checklist	
5	E	Install Building Control System	AAO #1 thru #4
6	E	Start-Up and Start-Up Testing	ACO #5
7	S	Post-Construction QC Checklist	ACO #6
8	S	Programming Software Configuration Software	ACO #6
9	S	Draft As-Built Drawings	ACO #6
10	S	Start-Up Testing Report	ACO #6

TABLE II. PROJECT SEQUENCING			
ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL)
11	S	PVT Procedures	before schedule start of #12 and AAO #10
12	E	Execute PVT	AAO #9 and #11
13	S	PVT Report	ACO #12
14	S	Controller Application Programs Controller Configuration Settings	AAO #13
15	S	Final As-Built Drawings	AAO #13
16	S	O&M Instructions	AAO #15
17	S	Training Documentation	AAO #10 and 14 days before scheduled start of #18
18	E	Training	AAO #16 and #17
19	S	Closeout QC Checklist	ACO #18

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

DDC Contractor Design Drawings; G

Draft As-Built Drawings; G

Final As-Built Drawings; G

SD-03 Product Data

Programming Software; G

Controller Application Programs; G

Configuration Software; G

Controller Configuration Settings; G

Proprietary Multi-Split Engineering Tool Software; G

Manufacturer's Product Data; G

SD-05 Design Data

Boiler Or Chiller Plant Gateway Request

SD-06 Test Reports

Start-Up Testing Report; G

PVT Procedures; G

PVT Report; G

Pre-Construction Quality Control (QC) Checklist; G

Post-Construction Quality Control (QC) Checklist; G

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G

Training Documentation; G

SD-11 Closeout Submittals

Enclosure Keys; G

Password Summary Report; G

Closeout Quality Control (QC) Checklist; G

1.7 DATA PACKAGE AND SUBMITTAL REQUIREMENTS

Technical data packages consisting of technical data and computer software (meaning technical data which relates to computer software) which are specifically identified in this project and which may be defined/required in other specifications must be delivered strictly in accordance with the CONTRACT CLAUSES and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered must be identified by reference to the particular specification paragraph against which it is furnished. All submittals not specified as technical data packages are considered 'shop drawings' under the Federal Acquisition Regulation Supplement (FARS) and must contain no proprietary information and be delivered with unrestricted rights.

1.8 SOFTWARE FOR DDC HARDWARE AND GATEWAYS

Provide all software related to the programming and configuration of DDC Hardware and Gateways as indicated. License all Software to the project site. The term "controller" as used in these requirements means both DDC Hardware and Gateways.

1.8.1 Configuration Software

For each type of controller, provide the configuration tool software in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. Submit hard copies of the software user manuals for each software with the software submittal.

Submit Configuration Software on CD-ROM as a Technical Data Package. Submit 3 hard copies of the software user manual for each piece of software.

1.8.2 Controller Configuration Settings

For each controller, provide copies of the installed configuration settings as source code compatible with the configuration tool software for that controller in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

Submit Controller Configuration Settings on CD-ROM as a Technical Data Package. Include on the CD-ROM a list or table of contents clearly indicating which files are associated with each device. Submit 2 copies of the Controller Configuration Settings CD-ROM.

1.8.3 Programming Software

For each type of programmable controller, provide the programming software in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. Submit hard copies of software user manuals for each software with the software submittal.

Submit Programming Software on CD-ROM as a Technical Data Package. Submit 3 hard copies of the software user manual for each piece of software.

1.8.4 Controller Application Programs

For each programmable controller, provide copies of the application program as source code compatible with the programming software for that controller in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

Submit Controller Application Programs on CD-ROM as a Technical Data Package. Include on the CD-ROM a list or table of contents clearly indicating which application program is associated with each device. Submit 2 copies of the Controller Application Programs CD-ROM.

1.9 BOILER OR CHILLER PLANT GATEWAY REQUEST

If requesting the use of a gateway to a boiler or chiller plant as indicated in paragraph Proprietary Systems Exempted From Open Protocol Requirements, submit a Boiler or Chiller Plant Gateway Request describing the configuration of the boilers or chillers including model numbers for equipment and controllers, the sequence of operation for the units, and a justification for the need to operate the units on a shared non-BACnet network.

1.10 QUALITY CONTROL CHECKLISTS

The QC Checklist for BACnet Systems in APPENDIX A of this Section must be completed by the Contractor's Chief Quality Control (QC) Representative and submitted as indicated.

The QC Representative must verify each item indicated and initial in the space provided to indicate that the requirement has been met. The QC Representative must sign and date the Checklist prior to submission to the

Government.

1.10.1 Pre-Construction Quality Control (QC) Checklist

Complete items indicated as Pre-Construction QC Checklist items in the QC Checklist. Submit four copies of the Pre-Construction QC Checklist.

1.10.2 Post-Construction Quality Control (QC) Checklist

Complete items indicated as Post-Construction QC Checklist items in the QC Checklist. Submit four copies of the Post-Construction QC Checklist.

1.10.3 Closeout Quality Control (QC) Checklist

Complete items indicated as Closeout QC Checklist items in the QC Checklist. Submit four copies of the Closeout QC Checklist.

PART 2 PRODUCTS

Provide products meeting the requirements of Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet or Niagara BACnet systems, other referenced Sections, and this Section.

2.1 GENERAL PRODUCT REQUIREMENTS

Units of the same type of equipment must be products of a single manufacturer. Each major component of equipment must have the manufacturer's name and address, and the model and serial number in a conspicuous place. Materials and equipment must be standard products of a manufacturer regularly engaged in the manufacturing of these and similar products. The standard products must have been in a satisfactory commercial or industrial use for two years prior to use on this project. The two year use must include applications of equipment and materials under similar circumstances and of similar size. DDC Hardware not meeting the two-year field service requirement is acceptable provided it has been successfully used by the Contractor in a minimum of two previous projects. The equipment items must be supported by a service organization. Items of the same type and purpose must be identical, including equipment, assemblies, parts and components.

2.2 PRODUCT DATA

Provide manufacturer's product data sheets documenting compliance with product specifications for each product provided under Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS, or this Section. Provide product data for all products in a single indexed compendium, organized by product type.

For all BACnet hardware: for each manufacturer, model and version (revision) of DDC Hardware provide the Protocol Implementation Conformance Statement (PICS) in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

Submit Manufacturer's Product Data on CD-ROM.

2.3 OPERATION ENVIRONMENT

Unless otherwise specified, provide products rated for continuous operation under the following conditions:

- a. Pressure: Pressure conditions normally encountered in the installed location.
- b. Vibration: Vibration conditions normally encountered in the installed location.
- c. Temperature:
 - (1) Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.
 - (2) Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of -35 to +151 degrees F and temperature conditions outside this range normally encountered at the installed location.
- d. Humidity: 10 to 95 percent relative humidity, noncondensing and humidity conditions outside this range normally encountered at the installed location.

2.4 WIRELESS CAPABILITY

For products incorporating any wireless capability (including but not limited to radio frequency (RF), infrared and optical), provide products for which wireless capability can be permanently disabled at the device. Optical and infrared capabilities may be disabled via a permanently affixed opaque cover plate.

2.5 ENCLOSURES

Enclosures supplied as an integral (pre-packaged) part of another product are acceptable. Provide two Enclosure Keys for each lockable enclosure on a single ring per enclosure with a tag identifying the enclosure the keys operate. Provide enclosures meeting the following minimum requirements:

2.5.1 Outdoors

For enclosures located outdoors, provide enclosures meeting NEMA 250 Type 4 requirements.

2.5.2 Mechanical and Electrical Rooms

For enclosures located in mechanical or electrical rooms, provide enclosures meeting NEMA 250 Type 4 requirements.

2.5.3 Other Locations

For enclosures in other locations including but not limited to occupied spaces, above ceilings, and in plenum returns, provide enclosures meeting NEMA 250 Type 1 requirements.

2.6 WIRE AND CABLE

Provide wire and cable meeting the requirements of NFPA 70 and NFPA 90A in addition to the requirements of this specification and referenced specifications.

2.6.1 Terminal Blocks

For terminal blocks which are not integral to other equipment, provide terminal blocks which are insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, suitable for DIN rail mounting, and which have enclosed sides or end plates and partition plates for separation.

2.6.2 Control Wiring for Binary Signals

For Control Wiring for Binary Signals, provide 18 AWG copper or thicker wire rated for 300-volt service.

2.6.3 Control Wiring for Analog Signals

For Control Wiring for Analog Signals, provide 18 AWG or thicker, copper, single- or multiple-twisted wire meeting the following requirements:

- a. minimum 2 inch lay of twist
- b. 100 percent shielded pairs
- c. at least 300-volt insulation
- d. each pair has a 20 AWG tinned-copper drain wire and individual overall pair insulation
- e. cables have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.6.4 Power Wiring for Control Devices

For 24-volt circuits, provide insulated copper 18 AWG or thicker wire rated for 300 VAC service. For 120-volt circuits, provide 14 AWG or thicker stranded copper wire rated for 600-volt service.

2.6.5 Transformers

Provide UL 5085-3 approved transformers. Select transformers sized so that the connected load is no greater than 80 percent of the transformer rated capacity.

PART 3 EXECUTION

3.1 INSTALLATION

Fully install and test the control system in accordance Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet systems, and this Section.

3.1.1 Dielectric Isolation

Provide dielectric isolation where dissimilar metals are used for connection and support. Install control system in a manner that provides clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. Install control system such that it does not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.2 Penetrations in Building Exterior

Make all penetrations through and mounting holes in the building exterior watertight.

3.1.3 Device Mounting Criteria

Install devices in accordance with the manufacturer's recommendations and as indicated and shown. Provide a weathershield for all devices installed outdoors. Provide clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. Provide clearance for mechanical and electrical system maintenance; do not not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.4 Labels and Tags

Key all labels and tags to the unique identifiers shown on the As-Built drawings. For labels exterior to protective enclosures provide engraved plastic labels mechanically attached to the enclosure or DDC Hardware. Labels inside protective enclosures may be attached using adhesive, but must not be hand written. For tags, provide plastic or metal tags mechanically attached directly to each device or attached by a metal chain or wire.

- a. Label all Enclosures and DDC Hardware.
- b. Tag Airflow measurement arrays (AFMA) with flow rate range for signal output range, duct size, and pitot tube AFMA flow coefficient.
- c. Tag duct static pressure taps at the location of the pressure tap

3.1.5 Surge Protection

3.1.5.1 Power-Line Surge Protection

Protect equipment connected to AC circuits to withstand power-line surges in accordance with IEEE C62.41. Do not use fuses for surge protection.

3.1.5.2 Surge Protection for Transmitter and Control Wiring

Protect DDC hardware against or provided DDC hardware capable of withstanding surges induced on control and transmitter wiring installed outdoors and as shown. Protect equipment against the following two waveforms:

- a. A waveform with a 10-microsecond rise time, a 1000-microsecond decay time and a peak current of 60 amps.
- b. A waveform with an 8-microsecond rise time, a 20-microsecond decay

time and a peak current of 500 amperes.

3.1.6 Basic Cybersecurity Requirements

3.1.6.1 Passwords

For all devices with a password, change the password from the default password. Do not use the same password for more than one device. Coordinate selection of passwords with Contracting Officer. Provide a Password Summary Report documenting the password for each device and describing the procedure to change the password for each device. DDC workstations are to require CAC authentication to gain access.

Provide two hardcopies of the Password Summary Report, each copy in its own sealed envelope.

3.1.6.2 Wireless Capability

Unless otherwise indicated, disable wireless capability (including but not limited to radio frequency (RF), infrared and optical) for all devices with wireless capability. Optical and infrared capabilities may be disabled via a permanently affixed opaque cover plate. Password protecting a wireless connections does not meet this requirement; the wireless capability must be disabled.

3.1.6.3 IP Network Physical Security

Install all IP Network media in conduit. Install all IP devices including but not limited to IP-enabled DDC hardware and IP Network Hardware in lockable enclosures.

3.2 DRAWINGS AND CALCULATIONS

Provide drawings in the form and arrangement indicated and shown. Use the same abbreviations, symbols, nomenclature and identifiers shown. Assign a unique identifier as shown to each control system element on a drawing. When packaging drawings, group schedules by system. When space allows, it is permissible to include multiple schedules for the same system on a single sheet. Except for drawings covering all systems, do not put information for different systems on the same sheet.

Submit hardcopy drawings on ISO A1 34 by 22 inches sheets, and electronic drawings in PDF and in AutoCAD format. In addition, submit electronic drawings in editable Excel format for all drawings that are tabular, including but not limited to the Point Schedule and Equipment Schedule.

- a. Submit DDC Contractor Design Drawings consisting of each drawing indicated with pre-construction information depicting the intended control system design and plans. Submit DDC Contractor Design Drawings as a single complete package: 3 hard copies and 3 copies on CD-ROM.
- b. Submit Draft As-Built Drawings consisting of each drawing indicated updated with as-built data for the system prior to PVT. Submit Draft As-Built Drawings as a single complete package: 3 hard copies and 3 copies on CD-ROM.
- c. Submit Final As-Built Drawings consisting of each drawing indicated updated with all final as-built data. Final As-Built Drawings as a

single complete package: 3 hard copies and 3 copies on CD-ROM.

3.2.1 Sample Drawings

Sample drawings in electronic format are available at the Whole Building Design Guide page for this section:

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-23-09-00>

These drawings may prove useful in demonstrating expected drawing formatting and example content and are provided for illustrative purposes only. Note that these drawings do not meet the content requirements of this Section and must be completed to meet project requirements.

3.2.2 Drawing Index and Legend

Provide an HVAC Control System Drawing Index showing the name and number of the building, military site, State or other similar designation, and Country. In the Drawing Index, list all Contractor Design Drawings, including the drawing number, sheet number, drawing title, and computer filename when used. In the Design Drawing Legend, show and describe all symbols, abbreviations and acronyms used on the Design Drawings. Provide a single Index and Legend for the entire drawing package.

3.2.3 Thermostat and Occupancy Sensor Schedule

Provide a thermostat and occupancy sensor schedule containing each thermostat's unique identifier, room identifier and control features and functions as shown. Provide a single thermostat and occupancy sensor schedule for the entire project.

3.2.4 Valve Schedule

Provide a valve schedule containing each valve's unique identifier, size, flow coefficient Kv (Cv), pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure to torque data, dimensions, and access and clearance requirements data. In the valve schedule include actuator selection data supported by calculations of the force required to move and seal the valve, access and clearance requirements. Provide a single valve schedule for the entire project.

3.2.5 Damper Schedule

Provide a damper schedule containing each damper's unique identifier, type (opposed or parallel blade), nominal and actual sizes, orientation of axis and frame, direction of blade rotation, actuator size and spring ranges, operation rate, positive positioner range, location of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. Include the AMCA 511 maximum leakage rate at the operating static-pressure differential for each damper in the Damper Schedule. Provide a single damper schedule for the entire project.

3.2.6 Project Summary Equipment Schedule

Provide a project summary equipment schedule containing the manufacturer, model number, part number and descriptive name for each control device, hardware and component provided under this specification. Provide a single project equipment schedule for the entire project.

3.2.7 Equipment Schedule

Provide system equipment schedules containing the unique identifier, manufacturer, model number, part number and descriptive name for each control device, hardware and component provided under this specification. Provide a separate equipment schedule for each HVAC system.

3.2.8 Occupancy Schedule

Provide an occupancy schedule drawing containing the same fields as the occupancy schedule Contract Drawing with Contractor updated information. Provide a single occupancy schedule for the entire project.

3.2.9 DDC Hardware Schedule

Provide a single DDC Hardware Schedule for the entire project and including following information for each device.

3.2.9.1 DDC Hardware Identifier

The Unique DDC Hardware Identifier for the device.

3.2.9.2 HVAC System

The system "name" used to identify a specific system (the name used on the system schematic drawing for that system).

3.2.9.3 BACnet Device Information

3.2.9.3.1 Device Object Identifier

The Device Object Identifier: The Object_Identifier of the Device Object

3.2.9.3.2 Network Number

The Network Number for the device.

3.2.9.3.3 MAC Address

The MAC Address for the device

3.2.9.3.4 BTL Listing

The BTL Listing of the device. If the device is listed under multiple BTL Profiles, indicate the profile that matches the use and configuration of the device as installed.

3.2.9.3.5 Proprietary Services Information

If the device uses non-standard ASHRAE 135 services as defined and permitted in Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS, indicate that the device uses non-standard services and include a description of all non-standard services used. Describe usage and content such that a device from another vendor can interoperate with the device using the non-standard service. Provide descriptions with sufficient detail to allow a device from a different manufacturer to be programmed to both read and write the non-standard service request:

- a. read: interpret the data contained in the non-standard service and;
- b. write: given similar data, generate the appropriate non-standard service request.

3.2.9.3.6 Alarming Information

Indicate whether the device is used for alarm generation, and which types of alarm generation the device implements: intrinsic, local algorithmic, remote algorithmic.

3.2.9.3.7 Scheduling Information

Indicate whether the device is used for scheduling.

3.2.9.3.8 Trending Information

Indicate whether the device is used for trending, and indicate if the device is used to trend local values, remote values, or both.

3.2.10 Points Schedule

Provide a Points Schedule in tabular form for each HVAC system, with the indicated columns and with each row representing a hardware point, network point or configuration point in the system.

- a. When a Points Schedule was included in the Contract Drawing package, use the same fields as the Contract Drawing with updated information in addition to the indicated fields.
- b. When Point Schedules are included in the contract package, items requiring contractor verification or input have been shown in angle brackets ("<" and ">"), such as <____> for a required entry or <value> for a value requiring confirmation. Complete all items in brackets as well as any blank cells. Do not modify values which are not in brackets without approval.

Points Schedule Columns must include:

3.2.10.1 Point Name

The abbreviated name for the point using the indicated naming convention.

3.2.10.2 Description

A brief functional description of the point such as "Supply Air Temperature".

3.2.10.3 DDC Hardware Identifier

The Unique DDC Hardware Identifier shown on the DDC Hardware Schedule and used across all drawings for the DDC Hardware containing the point.

3.2.10.4 Settings

The value and units of any setpoints, configured setpoints, configuration parameters, and settings related to each point.

3.2.10.5 Range

The range of values, including units, associated with the point, including but not limited to a zone temperature setpoint adjustment range, a sensor measurement range, occupancy values for an occupancy input, or the status of a safety.

3.2.10.6 Input or Output (I/O) Type

The type of input or output signal associated with the point. Use the following abbreviations for entries in this column:

- a. AI: The value comes from a hardware (physical) Analog Input
- b. AO: The value is output as a hardware (physical) Analog Output
- c. BI: The value comes from a hardware (physical) Binary Input
- d. BO: The value is output as a hardware (physical) Binary Output
- e. PULSE: The value comes from a hardware (physical) Pulse Accumulator Input
- f. NET-IN: The value is provided from the network (generally from another device). Use this entry only when the value is received from another device as part of scheduling or as part of a sequence of operation, not when the value is received on the network for supervisory functions such as trending, alarming, override or display at a user interface.
- g. NET-OUT: The value is provided to another controller over the network. Use this entry only when the value is transmitted to another device as part of scheduling or as part of a sequence of operation, not when the value is transmitted on the network for supervisory functions such as trending, alarming, override or display at a user interface.

3.2.10.7 Object and Property Information

The Object Type and Instance Number for the Object associated with the point. If the value of the point is not in the Present_Value Property, then also provide the Property ID for the Property containing the value of the point. Any point that is displayed at the front end or on an LDP, is trended, is used by another device on the network, or has an alarm condition must be documented here.

3.2.10.8 Network Data Exchange Information (Gets Data From, Sends Data To)

Provide the DDC Hardware Identifier of other DDC Hardware the point is shared with.

3.2.10.9 Override Information (Object Type and Instance Number)

For each point requiring an Override, indicate if the Object for the point is Commandable or, if the use of a separate Object was specifically approved by the Contracting Officer, provide the Object Type and Instance Number of the Object to be used in overriding the point.

3.2.10.10 Trend Object Information

For each point requiring a trend, indicate if the trend is Local or Remote, the trend Object type and the trend Object instance number. For remote trends provide the DDC Hardware Identifier for the device containing the trend Object in the Points Schedule notes.

3.2.10.11 Alarm Information

Indicate the Alarm Generation Type, Event Enrollment Object Instance Number, and Notification Class Object Instance Number for each point requiring an alarm. (Note that not all alarms will have Event Enrollment Objects.)

3.2.10.12 Configuration Information

Indicate the means of configuration associated with each point.

- a. For Operator Configurable Points indicate BACnet Object and Property information (Name, Type, Identifiers) containing the configurable value. Indicate whether the property is writable always, or only when Out_Of_Service is TRUE.
- b. For Configurable Points indicate the BACnet Object and Property information as for Operator Configurable points, or identification of the configurable settings from within the engineering software for the device or identification of the hardware settings on the device.

3.2.11 Riser Diagram

The Riser Diagram of the Building Control Network may be in tabular form, and must show all DDC Hardware and all Network Hardware, including network terminators. For each item, provide the unique identifier, common descriptive name, physical sequential order (previous and next device on the network), room identifier and location within room. A single riser diagram must be submitted for the entire system.

3.2.12 Control System Schematics

Provide control system schematics in the same form as the control system schematic Contract Drawing with Contractor updated information. Provide a control system schematic for each HVAC system.

3.2.13 Sequences of Operation

Provide HVAC control system sequence of operation and in the same format as the Contract Drawings. Within these drawings, refer to devices by their unique identifiers. Submit sequences of operation and control logic diagrams for each HVAC system

3.2.14 Controller, Motor Starter and Relay Wiring Diagram

Provide controller wiring diagrams as functional wiring diagrams which show the interconnection of conductors and cables to each controller and to the identified terminals of input and output devices, starters and package equipment. Show necessary jumpers and ground connections and the labels of all conductors. Identify sources of power required for control systems and for packaged equipment control systems back to the panel board circuit breaker number, controller enclosures, magnetic starter, or

packaged equipment control circuit. Show each power supply and transformer not integral to a controller, starter, or packaged equipment. Show the connected volt-ampere load and the power supply volt-ampere rating. Provide wiring diagrams for each HVAC system.

3.3 CONTROLLER TUNING

Tune each controller in a manner consistent with that described in the ASHRAE FUN IP and in the manufacturer's instruction manual. Tuning must consist of adjustment of the proportional, integral, and where applicable, the derivative (PID) settings to provide stable closed-loop control. Each loop must be tuned while the system or plant is operating at a high gain (worst case) condition, where high gain can generally be defined as a low-flow or low-load condition. Upon final adjustment of the PID settings, in response to a change in controller setpoint, the controlled variable must settle out at the new setpoint with no more than two (2) oscillations above and below setpoint. Upon settling out at the new setpoint the controller output must be steady. With the exception of naturally slow processes such as zone temperature control, the controller must settle out at the new setpoint within five (5) minutes. Set the controller to its correct setpoint and record and submit the final PID configuration settings with the O&M Instructions and on the associated Points Schedule.

3.4 START-UP

3.4.1 Start-Up Test

Perform the following startup tests for each control system to ensure that the described control system components are installed and functioning per this specification.

Adjust, calibrate, measure, program, configure, set the time schedules, and otherwise perform all necessary actions to ensure that the systems function as indicated and shown in the sequence of operation and other contract documents.

3.4.1.1 Systems Check

An item-by-item check must be performed for each HVAC system

3.4.1.1.1 Step 1 - System Inspection

With the system in unoccupied mode and with fan hand-off-auto switches in the OFF position, verify that power and main air are available where required and that all output devices are in their failsafe and normal positions. Inspect each local display panel to verify that all displays indicate shutdown conditions.

3.4.1.1.2 Step 2 - Calibration Accuracy Check

Perform a two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter by comparing the value from the test instrument to the network value provided by the DDC Hardware. Use digital indicating test instruments, such as digital thermometers, motor-driven psychrometers, and tachometers. Use test instruments with accuracy at least twice as accurate as the specified sensor accuracy and with calibration traceable to National Institute of Standards and Technology standards. Check one the first check point in the bottom

one-third of the sensor range, and the second in the top one-third of the sensor range. Verify that the sensing element-to-DDC readout accuracies at two points are within the specified product accuracy tolerances, and if not recalibrate or replace the device and repeat the calibration check.

3.4.1.1.3 Step 3 - Actuator Range Check

With the system running, apply a signal to each actuator through the DDC Hardware controller. Verify proper operation of the actuators and positioners for all actuated devices and record the signal levels for the extreme positions of each device. Vary the signal over its full range, and verify that the actuators travel from zero stroke to full stroke within the signal range. Where applicable, verify that all sequenced actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other. For valve actuators and damper actuators, perform the actuator range check under normal system pressures.

3.4.1.2 Weather Dependent Test

Perform weather dependent test procedures in the appropriate climatic season.

3.4.2 Start-Up Testing Report

Submit 4 copies of the Start-Up Testing Report. The report may be submitted as a Technical Data Package documenting the results of the tests performed and certifying that the system is installed and functioning per this specification, and is ready for the Performance Verification Test (PVT).

3.5 PERFORMANCE VERIFICATION TEST (PVT)

3.5.1 PVT Procedures

Prepare PVT Procedures explaining step-by-step, the actions and expected results that will demonstrate that the control system performs in accordance with the sequences of operation, and other contract documents. Submit 4 copies of the PVT Procedures. The PVT Procedures may be submitted as a Technical Data Package.

3.5.1.1 Sensor Accuracy Checks

Include a one-point accuracy check of each sensor in the PVT procedures.

3.5.1.2 Endurance Test

Include a one-week endurance test as part of the PVT during which the system is operated continuously.

Use the building control system BACnet Trend Log or Trend Log Multiple Objects to trend all points shown as requiring a trend on the Point Schedule for the entire endurance test. If insufficient buffer capacity exists to trend the entire endurance test, upload trend logs during the course of the endurance test to ensure that no trend data is lost.

3.5.1.3 PVT Equipment List

Include in the PVT procedures a control system performance verification

test equipment list that lists the equipment to be used during performance verification testing. For each piece of equipment, include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration

3.5.2 PVT Execution

Demonstrate compliance of the control system with the contract documents. Using test plans and procedures approved by the Government, software capable of reading and writing COV Notification Subscriptions, Notification Class Recipient List Properties, event enrollments, demonstrate all physical and functional requirements of the project. Show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. Do not start the performance verification test until after receipt of written permission by the Government, based on Government approval of the PVT Plan and Draft As-Built and completion of balancing. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. Do not conduct tests during scheduled seasonal off periods of base heating and cooling systems. If the system experiences any failures during the endurance test portion of the PVT, repair the system repeat the endurance test portion of the PVT until the system operates continuously and without failure for the specified endurance test period.

3.5.3 PVT Report

Prepare and submit a PVT report documenting all tests performed during the PVT and their results. Include all tests in the PVT procedures and any additional tests performed during PVT. Document test failures and repairs conducted with the test results.

Submit four copies of the PVT Report. The PVT Report may be submitted as a Technical Data Package.

3.6 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

Provide HVAC control System Operation and Maintenance Instructions which include:

- a. "Data Package 3" as indicated in Section 01 78 23 OPERATION AND MAINTENANCE DATA for each piece of control equipment.
- b. "Data Package 4" as described in Section 01 78 23 OPERATION AND MAINTENANCE DATA for all air compressors.
- c. HVAC control system sequences of operation formatted as indicated.
- d. Procedures for the HVAC system start-up, operation and shut-down including the manufacturer's supplied procedures for each piece of equipment, and procedures for the overall HVAC system.
- e. As-built HVAC control system detail drawings formatted as indicated.
- f. Routine maintenance checklist. Provide the routine maintenance checklist arranged in a columnar format, where the first column lists all installed devices, the second column states the maintenance activity or that no maintenance required, the third column states the frequency of the maintenance activity, and the fourth column is used

for additional comments or reference.

- g. Qualified service organization list, including at a minimum company name, contact name and phone number.
- h. Start-Up Testing Report.
- i. Performance Verification Test (PVT) Procedures and Report.

Submit 2 copies of the Operation and Maintenance Instructions, indexed and in booklet form. The Operation and Maintenance Instructions may be submitted as a Technical Data Package.

3.7 MAINTENANCE AND SERVICE

Provide services, materials and equipment as necessary to maintain the entire system in an operational state as indicated for a period of one year after successful completion and acceptance of the Performance Verification Test. Minimize impacts on facility operations.

- a. The integration of the system specified in this section into a Utility Monitoring and Control System must not, of itself, void the warranty or otherwise alter the requirement for the one year maintenance and service period. Integration into a UMCS includes but is not limited to establishing communication between devices in the control system and the front end or devices in another system.
- b. The changing of configuration properties must not, of itself, void the warranty or otherwise alter the requirement for the one year maintenance and service period.

3.7.1 Description of Work

Provide adjustment and repair of the system including the manufacturer's required sensor and actuator (including transducer) calibration, span and range adjustment.

3.7.2 Personnel

Use only service personnel qualified to accomplish work promptly and satisfactorily. Advise the Government in writing of the name of the designated service representative, and of any changes in personnel.

3.7.3 Scheduled Inspections

Perform two inspections at six-month intervals and provide work required. Perform inspections in June and December. During each inspection perform the indicated tasks:

- a. Perform visual checks and operational tests of equipment.
- b. Clean control system equipment including interior and exterior surfaces.
- c. Check and calibrate each field device. Check and calibrate 50 percent of the total analog inputs and outputs during the first inspection. Check and calibrate the remaining 50 percent of the analog inputs and outputs during the second major inspection. Certify analog test instrumentation accuracy to be twice the specified accuracy of the

device being calibrated. Randomly check at least 25 percent of all binary inputs and outputs for proper operation during the first inspection. Randomly check at least 25 percent of the remaining binary inputs and outputs during the second inspection. If more than 20 percent of checked inputs or outputs failed the calibration check during any inspection, check and recalibrate all inputs and outputs during that inspection.

- d. Run system software diagnostics and correct diagnosed problems.
- e. Resolve any previous outstanding problems.

3.7.4 Scheduled Work

This work must be performed during regular working hours, Monday through Friday, excluding Federal holidays.

3.7.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel must be available to provide service to the system. A telephone number where the service supervisor can be reached at all times must be provided. Service personnel must be at the site within 24 hours after receiving a request for service. The control system must be restored to proper operating condition as required per Section 01 78 00 CLOSEOUT SUBMITTALS.

3.7.6 Operation

After performing scheduled adjustments and repairs, verify control system operation as demonstrated by the applicable tests of the performance verification test.

3.7.7 Records and Logs

Keep dated records and logs of each task, with cumulative records for each major component, and for the complete system chronologically. Maintain a continuous log for all devices, including initial analog span and zero calibration values and digital points. Keep complete logs and provide logs for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

3.7.8 Work Requests

Record each service call request as received and include its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. Submit a record of the work performed within 5 days after work is accomplished.

3.7.9 System Modifications

Submit recommendations for system modification in writing. Do not make system modifications, including operating parameters and control settings, without prior approval of the Government.

3.8 TRAINING

Conduct a training course for 2 operating staff members designated by the Government in the maintenance and operation of the system, including specified hardware and software. Conduct 8 hours of training at the project site within 30 days after successful completion of the performance verification test. The Government reserves the right to make audio and visual recordings (using Government supplied equipment) of the training sessions for later use. Provide audiovisual equipment and other training materials and supplies required to conduct training. A training day is defined as 8 hours of classroom instruction, including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

3.8.1 Training Documentation

Prepare training documentation consisting of:

- a. Course Attendee List: Develop the list of course attendees in coordination with and signed by the Controls and HVAC shop supervisor.
- b. Training Manuals: Provide training manuals which include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. When presenting portions of the course material by audiovisuals, deliver copies of those audiovisuals as a part of the printed training manuals.

3.8.2 Training Course Content

For guidance in planning the required instruction, assume that attendees will have a high school education, and are familiar with HVAC systems. During the training course, cover all of the material contained in the Operating and Maintenance Instructions, the layout and location of each controller enclosure, the layout of one of each type of equipment and the locations of each, the location of each control device external to the panels, the location of the compressed air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. Present the results of the performance verification test and the Start-Up Testing Report as benchmarks of HVAC control system performance by which to measure operation and maintenance effectiveness.

3.8.3 Training Documentation Submittal Requirements

Submit hardcopy training manuals and all training materials on CD-ROM. Provide one hardcopy manual for each trainee on the Course Attendee List and 2 additional copies for archive at the project site. Provide 2 copies of the Course Attendee List with the archival copies. Training Documentation may be submitted as a Technical Data Package.

APPENDIX A

<u>QC CHECKLIST FOR BACNET SYSTEMS</u>		
<p>This checklist is not all-inclusive of the requirements of this specification and should not be interpreted as such.</p> <p>Instructions: Initial each item in the space provided (____) verifying that the requirement has been met.</p>		
<p>This checklist is for (circle one:)</p> <p>Pre-Construction QC Checklist Submittal</p> <p>Post-Construction QC Checklist Submittal</p> <p>Close-out QC Checklist Submittal</p>		
Items verified for Pre-Construction, Post-Construction and Closeout QC Checklist Submittals:		
1	All DDC Hardware is numbered on Control System Schematic Drawings.	____
2	Signal lines on Control System Schematic are labeled with the signal type.	____
3	Local Display Panel (LDP) Locations are shown on Control System Schematic drawings.	____
Items verified for Post-Construction and Closeout QC Checklist Submittals:		
4	All sequences are performed as specified using DDC Hardware.	____
5	Training schedule and course attendee list has been developed and coordinated with shops and submitted.	____
Items verified for Closeout QC Checklist Submittal:		
6	Final As-built Drawings, including all Points Schedule drawings, accurately represent the final installed system.	____
7	Programming software has been submitted for all programmable controllers.	____
8	All software has been licensed to the Government.	

<u>QC CHECKLIST FOR BACNET SYSTEMS</u>		
9	O&M Instructions have been completed and submitted.	____
10	Training course has been completed.	____
11	All DDC Hardware is installed on a BACnet ASHRAE 135 network using either MS/TP in accordance with Clause 9 or IP in accordance with Annex J.	____
12	All DDC Hardware is BTL listed.	____
13	Communication between DDC Hardware is only via BACnet using standard services, except as specifically permitted by the specification. Non-standard services have been fully documented in the DDC Hardware Schedule.	____
14	Scheduling, Alarming, and Trending have been implemented using the standard BACnet Objects for these functions.	____
15	All Properties indicated as required to be Writable are Writable and Overrides have been provided as indicated	____
<hr/>		
	(QC Representative Signature)	(Date)

-- End of Section --

SECTION 23 09 13

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
11/15, CHG 1: 11/20

PART 1 GENERAL

1.1 SUMMARY

This section provides for the instrumentation control system components excluding direct digital controllers, network controllers, gateways etc. that are necessary for a completely functional automatic control system. When combined with a Direct Digital Control (DDC) system, the Instrumentation and Control Devices covered under this section must be a complete system suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as specified and indicated.

- a. Install hardware to perform the control sequences as specified and indicated and to provide control of the equipment as specified and indicated.
- b. Install hardware such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.
- c. Install and configure hardware such that the Government or their agents are able to perform repair, replacement, and upgrades of individual hardware without further interaction with the installing Contractor.

1.1.1 Verification of Dimensions

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.1.2 Drawings

The Government will not indicate all offsets, fittings, and accessories that may be required on the drawings. Carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, arrange such work accordingly, and provide all work necessary to meet such conditions.

1.2 RELATED SECTIONS

Related work specified elsewhere.

Section 01 30 00 ADMINISTRATIVE REQUIREMENTS

Section 23 30 00 HVAC AIR DISTRIBUTION

Section 23 21 13.00 20 LOW TEMPERATURE WATER (LTW) HEATING SYSTEM

Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

- | | |
|------------|---|
| AMCA 500-D | (2018) Laboratory Methods of Testing
Dampers for Rating |
| AMCA 511 | (2010; R 2016) Certified Ratings Program
for Air Control Devices |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- | | |
|-------------|---|
| ASME B16.15 | (2018) Cast Copper Alloy Threaded Fittings
Classes 125 and 250 |
| ASME B16.34 | (2017) Valves - Flanged, Threaded and
Welding End |

ASTM INTERNATIONAL (ASTM)

- | | |
|-----------|--|
| ASTM A536 | (1984; R 2019; E 2019) Standard
Specification for Ductile Iron Castings |
|-----------|--|

FLUID CONTROLS INSTITUTE (FCI)

- | | |
|----------|-----------------------------------|
| FCI 70-2 | (2013) Control Valve Seat Leakage |
|----------|-----------------------------------|

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- | | |
|----------|---|
| IEEE 142 | (2007; Errata 2014) Recommended Practice
for Grounding of Industrial and Commercial
Power Systems - IEEE Green Book |
|----------|---|

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- | | |
|----------|---|
| NFPA 70 | (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code |
| NFPA 90A | (2021) Standard for the Installation of
Air Conditioning and Ventilating Systems |

UNDERWRITERS LABORATORIES (UL)

- | | |
|-----------|---|
| UL 5085-3 | (2006; Reprint Nov 20121) Low Voltage
Transformers - Part 3: Class 2 and Class 3
Transformers |
|-----------|---|

1.4 SUBMITTALS

Submittal requirements are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.5 DELIVERY AND STORAGE

Store and protect products from the weather, humidity, and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.

1.6 INPUT MEASUREMENT ACCURACY

Select, install and configure sensors, transmitters and DDC Hardware such that the maximum error of the measured value at the input of the DDC hardware is less than the maximum allowable error specified for the sensor or instrumentation.

1.7 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph entitled CONTRACTOR SPECIAL REQUIREMENTS in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 General Requirements

All products used to meet this specification must meet the indicated requirements, but not all products specified here will be required by every project. All products must meet the requirements both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section.

2.1.2 Operation Environment Requirements

Unless otherwise specified, provide products rated for continuous operation under the following conditions:

2.1.2.1 Pressure

Pressure conditions normally encountered in the installed location.

2.1.2.2 Vibration

Vibration conditions normally encountered in the installed location.

2.1.2.3 Temperature

- a. Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.
- b. Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of -35 to +151 degrees F and temperature conditions outside this range normally encountered at the installed location.

2.1.2.4 Humidity

10 to 95 percent relative humidity, non-condensing and also humidity conditions outside this range normally encountered at the installed

location.

2.2 WEATHERSHIELDS

Provide weathershields constructed of galvanized steel painted white, unpainted aluminum, aluminum painted white, or white PVC.

2.3 WIRE AND CABLE

Provide wire and cable meeting the requirements of NFPA 70 and NFPA 90A in addition to the requirements of this specification and referenced specifications.

2.3.1 Terminal Blocks

For terminal blocks which are not integral to other equipment, provide terminal blocks which are insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, suitable for DIN rail mounting, and which have enclosed sides or end plates and partition plates for separation.

2.3.2 Control Wiring for Binary Signals

For Control Wiring for Binary Signals, provide 18 AWG copper or thicker wire rated for 300-volt service.

2.3.3 Control Wiring for Analog Signals

For Control Wiring for Analog Signals, provide 18 AWG or thicker, copper, single- or multiple-twisted wire meeting the following requirements:

- a. minimum 2 inch lay of twist
- b. 100 percent shielded pairs
- c. at least 300-volt insulation
- d. each pair has a 20 AWG tinned-copper drain wire and individual overall pair insulation
- e. cables have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.3.4 Power Wiring for Control Devices

For 24-volt circuits, provide insulated copper 18 AWG or thicker wire rated for 300 VAC service. For 120-volt circuits, provide 14 AWG or thicker stranded copper wire rated for 600-volt service.

2.3.5 Transformers

Provide UL 5085-3 approved transformers. Select transformers sized so that the connected load is no greater than 80 percent of the transformer rated capacity.

2.4 AUTOMATIC CONTROL VALVES

Provide valves with stainless-steel stems and stuffing boxes with extended

necks to clear the piping insulation. Provide valves with bodies meeting ASME B16.34 or ASME B16.15 pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure. Unless otherwise specified or indicated, provide valves meeting FCI 70-2 Class III leakage rating. Provide valves rated for modulating or two-position service as indicated, which close against a differential pressure indicated as the Close-Off pressure and which are Normally-Open, Normally-Closed, or Fail-In-Last-Position as indicated.

2.4.1 Valve Type

2.4.1.1 Liquid Service 150 Degrees F or Less

Use either globe valves or ball valves except that butterfly valves may be used for sizes 4 inch and larger.

2.4.1.2 Liquid Service Above 150 Degrees F

- a. Two-position valves: Use either globe valves or ball valves except that butterfly valves may be used for sizes 4 inch and larger.
- b. Modulating valves: Use globe valves except that butterfly valves may be used for sizes 4 inch and larger.

2.4.2 Valve Flow Coefficient and Flow Characteristic

2.4.2.1 Two-Way Modulating Valves

Provide the valve coefficient (Cv) indicated. Provide equal-percentage flow characteristic for liquid service except for butterfly valves. Provide linear flow characteristic for steam service except for butterfly valves.

2.4.3 Two-Position Valves

Use full line size full port valves with maximum available (Cv).

2.4.4 Globe Valves

2.4.4.1 Liquid Service Not Exceeding 150 Degrees F

- a. Valve body and body connections:
 - (1) valves 1-1/2 inches and smaller: brass or bronze body, with threaded or union ends
 - (2) valves from 2 inches to 3 inches inclusive: brass, bronze, or iron bodies. 2 inch valves with threaded connections; 2-1/2 to 3 inches valves with flanged connections
- b. Internal valve trim: Brass or bronze.
- c. Stems: Stainless steel.

2.4.4.2 Liquid Service Not Exceeding 250 Degrees F

- a. Valve body and body connections:
 - (1) valves 1-1/2 inches and smaller: brass or bronze body, with

threaded or union ends

(2) valves from 2 inches to 3 inches inclusive: brass, bronze, or iron bodies. 2 inch valves with threaded connections; 2-1/2 to 3 inches valves with flanged connections

- b. Internal trim: Type 316 stainless steel including seats, seat rings, modulation plugs, valve stems, and springs.
- c. Provide valves with non-metallic parts suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher.

2.4.5 Ball Valves

2.4.5.1 Liquid Service Not Exceeding 150 Degrees F

- a. Valve body and connections:

(1) valves 1-1/2 inches and smaller: bodies of brass or bronze, with threaded or union ends

(2) valves from 2 inches to 3 inches inclusive: bodies of brass, bronze, or iron. 2 inch valves with threaded connections; valves from 2-1/2 to 3 inches with flanged connections.

- b. Ball: Stainless steel or nickel-plated brass or chrome-plated brass.
- c. Seals: Reinforced Teflon seals and EPDM O-rings.
- d. Stem: Stainless steel, blow-out proof.
- e. Provide valves compatible with a solution of 50 percent ethylene or propylene glycol.

2.4.6 Butterfly Valves

Provide butterfly valves which are threaded lug type suitable for dead-end service and modulation to the fully-closed position, with carbon-steel bodies or with ductile iron bodies in accordance with ASTM A536. Provide butterfly valves with non-corrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from -20 to +250 degrees F. Provide valves with rated Cv of the Cv at 70 percent (60 degrees) open position. Provide valves meeting FCI 70-2 Class VI leakage rating.

2.4.7 Duct-Coil and Terminal-Unit-Coil Valves

For duct or terminal-unit coils provide control valves with either screw type or solder-type ends. Provide flare nuts for each flare-type end valve.

2.5 DAMPERS

2.5.1 Damper Assembly

Provide single damper sections with blades no longer than 48 inches and which are no higher than 72 inches and damper blade width of 8 inches or less. When larger sizes are required, combine damper sections. Provide

dampers made of galvanized steel and with assembly frames constructed of 0.07 inch minimum thickness galvanized steel channels with mitered and welded corners. Steel channel frames constructed of 0.06 inch minimum thickness are acceptable provided the corners are reinforced.

- a. Flat blades must be made rigid by folding the edges. Blade-operating linkages must be within the frame so that blade-connecting devices within the same damper section must not be located directly in the air stream.
- b. Damper axles must be 1/2 inch minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically must be supported by thrust bearings.
- c. Provide dampers which do not exceed a pressure drop through the damper of 0.04 inches water gauge at 1000 ft/min in the wide-open position. Provide dampers with frames not less than 2 inch in width. Provide dampers which have been tested in accordance with AMCA 500-D.

2.5.2 Operating Linkages

For operating links external to dampers, such as crank arms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, provide links able to withstand a load equal to at least 300 percent of the maximum required damper-operating force without deforming. Rod lengths must be adjustable. Links must be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises must be brass, bronze, or stainless steel. Adjustments of crank arms must control the open and closed positions of dampers.

2.5.3 Damper Types

2.5.3.1 Flow Control Dampers

Provide parallel-blade or opposed blade type dampers for outside air, return air, relief air, exhaust, face and bypass dampers as indicated on the Damper Schedule. Blades must have interlocking edges. The channel frames of the dampers must be provided with jamb seals to minimize air leakage. Unless otherwise indicated, dampers must meet AMCA 511 Class 1A requirements. Outside air damper seals must be suitable for an operating temperature range of -40 to +167 degrees F. Dampers must be rated at not less than 2000 ft/min air velocity.

2.5.3.2 Mechanical Rooms and Other Utility Space Ventilation Dampers

Provide utility space ventilation dampers as indicated. Unless otherwise indicated provide AMCA 511 class 1 dampers. Provide dampers rated at not less than 1500 ft/min air velocity.

2.5.3.3 Smoke Dampers

See Section 23 30 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS.

2.6 SENSORS AND INSTRUMENTATION

Unless otherwise specified, provide sensors and instrumentation which incorporate an integral transmitter. Sensors and instrumentation, including their transmitters, must meet the specified accuracy and drift

requirements at the input of the connected DDC Hardware's analog-to-digital conversion.

2.6.1 Analog and Binary Transmitters

Provide transmitters which match the characteristics of the sensor. Transmitters providing analog values must produce a linear 4-20 mA_{dc}, 0-10 V_{dc} signal corresponding to the required operating range and must have zero and span adjustment. Transmitters providing binary values must have dry contacts rated at 1A at 24 Volts AC.

2.6.2 Network Transmitters

Sensors and Instrumentation incorporating an integral network connection are considered DDC Hardware and must meet the DDC Hardware requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS when used in a BACnet network.

2.6.3 Temperature Sensors

Provide the same sensor type throughout the project. Temperature sensors may be provided without transmitters. Where transmitters are used, the range must be the smallest available from the manufacturer and suitable for the application such that the range encompasses the expected range of temperatures to be measured. The end to end accuracy includes the combined effect of sensitivity, hysteresis, linearity and repeatability between the measured variable and the end user interface (graphic presentation) including transmitters if used.

2.6.3.1 Sensor Accuracy and Stability of Control

2.6.3.1.1 Conditioned Space Temperature

Plus or minus 0.5 degree F over the operating range.

2.6.3.1.2 Unconditioned Space Temperature

- a. Plus or minus 1 degree F over the range of 30 to 131 degrees F AND
- b. Plus or minus 4 degrees F over the rest of the operating range.

2.6.3.1.3 Duct Temperature

Plus or minus 0.5 degree F

2.6.3.1.4 Outside Air Temperature

- a. Plus or minus 2 degrees F over the range of -30 to +130 degrees F AND
- b. Plus or minus 1 degree F over the range of 30 to 130 degrees F.

2.6.3.1.5 Heating Hot Water

Plus or minus 2 degrees F.

2.6.3.2 Transmitter Drift

The maximum allowable transmitter drift: 0.25 degrees F per year.

2.6.3.3 Point Temperature Sensors

Point Sensors must be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper.

2.6.3.4 Temperature Sensor Details

2.6.3.4.1 Room Type

Provide the sensing element components within a decorative protective cover suitable for surrounding decor.

2.6.3.4.2 Duct Probe Type

Ensure the probe is long enough to properly sense the air stream temperature.

2.6.3.4.3 Duct Averaging Type

Continuous averaging sensors must be one foot in length for each 1 square foot of duct cross-sectional area, and a minimum length of 5 feet.

2.6.3.4.4 Pipe Immersion Type

Provide minimum 3 inch immersion. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells must be stainless steel when used in steel piping, and brass when used in copper piping.

2.6.3.4.5 Outside Air Type

Provide the sensing element rated for outdoor use

2.6.4 Relative Humidity Sensor

Relative humidity sensors must use bulk polymer resistive or thin film capacitive type non-saturating sensing elements capable of withstanding a saturated condition without permanently affecting calibration or sustaining damage. The sensors must include removable protective membrane filters. Where required for exterior installation, sensors must be capable of surviving below freezing temperatures and direct contact with moisture without affecting sensor calibration. When used indoors, the sensor must be capable of being exposed to a condensing air stream (100 percent relative humidity) with no adverse effect to the sensor's calibration or other harm to the instrument. The sensor must be of the wall-mounted or duct-mounted type, as required by the application, and must be provided with any required accessories. Sensors used in duct high-limit applications must have a bulk polymer resistive sensing element. Duct-mounted sensors must be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. Relative humidity (RH) sensors must measure relative humidity over a range of 0 percent to 100 percent with an accuracy of plus or minus 2 percent. RH sensors must function over a temperature range of 40 to 135 degrees F and must not drift more than 1 percent per year.

2.6.5 Differential Pressure Instrumentation

2.6.5.1 Differential Pressure Sensors

Provide Differential Pressure Sensors with ranges as indicated or as required for the application. Pressure sensor ranges must not exceed the high end range indicated on the Points Schedule by more than 50 percent. The over pressure rating must be a minimum of 150 percent of the highest design pressure of either input to the sensor. The accuracy must be plus or minus 1 percent of full scale. The sensor must have a maximum drift of 2 percent per year

2.6.5.2 Differential Pressure Switch

Provide differential pressure switches with a user-adjustable setpoint which are sized for the application such that the setpoint is between 25 percent and 75 percent of the full range. The over pressure rating must be a minimum of 150 percent of the highest design pressure of either input to the sensor. The switch must have two sets of contacts and each contact must have a rating greater than it's connected load. Contacts must open or close upon rise of pressure above the setpoint or drop of pressure below the setpoint as indicated.

2.6.6 Flow Sensors

2.6.6.1 Airflow Measurement Array (AFMA)

2.6.6.1.1 Airflow Straightener

Provide AFMAs which contain an airflow straightener if required by the AFMA manufacturer's published installation instructions. The straightener must be contained inside a flanged sheet metal casing, with the AFMA located as specified according to the published recommendation of the AFMA manufacturer. In the absence of published documentation, provide airflow straighteners if there is any duct obstruction within 5 duct diameters upstream of the AFMA. Air-flow straighteners, where required, must be constructed of 0.125 inch aluminum honeycomb and the depth of the straightener must not be less than 1.5 inches.

2.6.6.1.2 Resistance to Airflow

The resistance to air flow through the AFMA, including the airflow straightener must not exceed 0.085 inch water gauge at an airflow of 2,000 fpm. AFMA construction must be suitable for operation at airflows of up to 5000 fpm over a temperature range of 40 to 120 degrees F.

2.6.6.1.3 Outside Air Temperature

In outside air measurement or in low-temperature air delivery applications, provide an AFMA certified by the manufacturer to be accurate as specified over a temperature range of -20 to +120 degrees F.

2.6.6.1.4 Electronic AFMA

Each electronic AFMA must consist of an array of velocity sensing elements of the resistance temperature detector (RTD) or thermistor type. The sensing elements must be distributed across the duct cross section in the quantity and pattern specified or recommended by the published application data of the AFMA manufacturer. Electronic AFMAs must have an accuracy of

plus or minus 5 percent over a range of 125 to 5,000 fpm and the output must be temperature compensated over a range of 32 to 212 degrees F.

2.6.6.1.5 Fan Inlet Measurement Devices

Fan Inlet measurement devices shall be electronic AFMA type designed for fan inlet mounting. See paragraph Electronic AFMA for other technical requirements.

2.6.6.2 Insertion Turbine Flowmeter

Provide dual axial turbine flowmeter with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. All parts must meet or exceed the pressure classification of the pipe system it is installed in. Insertion Turbine Flowmeter accuracy must be plus or minus 0.5 percent of rate at calibrated velocity., within plus or minus of rate over a 10:1 turndown and within plus or minus 2 percent of rate over a 50:1 turndown. Repeatability must be plus or minus 0.25 percent of reading. The meter flow sensing element must operate over a range suitable for the installed location with a pressure loss limited to 1 percent of operating pressure at maximum flow rate. The flowmeter ,must include either dry contact pulse outputs, 4-20mA, 0-10Vdc or 0-5Vdc outputs. The turbine rotor assembly must be constructed of Series 300 stainless steel and use Teflon seals.

2.6.6.3 Insertion Magnetic Flow Meter

Provide insertion type magnetic flowmeters with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. All parts must meet or exceed the pressure classification of the pipe system it is installed in. Flowmeter accuracy must be no greater than plus or minus 1 percent of rate from 2 to 20 feet/sec. Wetted material parts must be 300 series stainless steel. The flowmeter must include either dry contact pulse outputs, 4-20mA, 0-10Vdc or 0-5Vdc outputs.

2.6.6.4 Flow Switch

Flow switch must have a repetitive accuracy of plus or minus 10 percent of actual flow setting. Switch actuation must be adjustable over the operating flow range, and must be sized for the application such that the setpoint is between 25 percent and 75 percent of the full range. The switch must have Form C snap-action contacts, rated for the application. The flow switch must have non flexible paddle with magnetically actuated contacts and be rated for service at a pressure greater than the installed conditions. Flow switch for use in sewage system must be rated for use in corrosive environments encountered.

2.6.6.5 Gas Flow Meter

Gas flow meter must be diaphragm or bellows type (gas positive displacement meters) for flows up to 2500 SCFH and axial flow turbine type for flows above 2500 SCFH, designed specifically for natural gas supply metering, and rated for the pressure, temperature, and flow rates of the installation. Meter must have a minimum turndown ratio of 10 to 1 with an accuracy of plus or minus 1 percent of actual flow rate. The meter index must include a direct reading mechanical totalizing register and electrical impulse dry contact output for remote monitoring. The electrical impulse dry contact output must not require field adjustment or

calibration. The electrical impulse dry contact output must have a minimum resolution of 100 cubic feet of gas per pulse and must not exceed 15 pulses per second at the design flow.

2.6.7 Electrical Instruments

Provide Electrical Instruments with an input range as indicated or sized for the application. Unless otherwise specified, AC instrumentation must be suitable for 60 Hz operation.

2.6.7.1 Current Transducers

Current transducers must accept an AC current input and must have an accuracy of plus or minus 0.5 percent of full scale. The device must have a means for calibration. Current transducers for variable frequency applications must be rated for variable frequency operation.

2.6.7.2 Current Sensing Relays (CSRs)

Current sensing relays (CSRs) must provide a normally-open contact with a voltage and amperage rating greater than its connected load. Current sensing relays must be of split-core design. The CSR must be rated for operation at 200 percent of the connected load. Voltage isolation must be a minimum of 600 volts. The CSR must auto-calibrate to the connected load or be adjustable and field calibrated. Current sensors for variable frequency applications must be rated for variable frequency operation.

2.6.7.3 Voltage Transducers

Voltage transducers must accept an AC voltage input and have an accuracy of plus or minus 0.25 percent of full scale. The device must have a means for calibration. Line side fuses for transducer protection must be provided.

2.6.7.4 Energy Metering

2.6.7.4.1 Hydronic BTU Meters

The BTU meter is to be supplied with wall mount hardware and be capable of being installed remote from the flow meter. The BTU meter must include an LCD display for local indication of energy rate and for display of parameters and settings during configuration. Each BTU meter must be factory configured for its specific application and be completely field configurable by the user via a front panel keypad (no special interface device or computer required). The unit must output Energy Rate, Energy Total, Flow Rate, Supply Temperature, and Return Temperature. An integral transmitter is to provide a linear analog or configurable pulse output signal representing the energy rate; and the signal must be compatible with building automation system DDC Hardware to which the output is connected.

2.6.8 Occupancy Sensors

Occupancy sensors must have occupancy-sensing sensitivity adjustment and an adjustable off-delay timer with a setpoint of 15 minutes. Adjustments accessible from the face of the unit are preferred. Occupancy sensors must be rated for operation in ambient air temperatures ranging from 40 to 95 degrees F or temperatures normally encountered in the installed location. Sensors integral to wall mount on-off light switches must have

an auto-off switch. Wall switch sensors must be decorator style and must fit behind a standard decorator type wall plate. All occupancy sensors, power packs, and slave packs must be UL listed. In addition to any outputs required for lighting control, the occupancy sensor must provide an output for the HVAC control system.

2.6.8.1 Passive Infrared (PIR) Occupancy Sensors

PIR occupancy sensors must have a multi-level, multi-segmented viewing lens and a conical field of view with a viewing angle of 180 degrees and a detection of at least 20 feet unless otherwise indicated or specified. PIR Sensors must provide field-adjustable background light-level adjustment with an adjustment range suitable to the light level in the sensed area, room or space. PIR sensors must be immune to false triggering from RFI and EMI.

2.6.8.2 Ultrasonic Occupancy Sensors

Ultrasonic sensors must operate at a minimum frequency 32 kHz and must be designed to not interfere with hearing aids.

2.6.9 Carbon Dioxide (CO2) Sensors

Provide photometric type CO2 sensors with integral transducers and linear output. Carbon dioxide (CO2) sensors must measure CO2 concentrations between 0 to 2000 parts per million (ppm) using non-dispersible infrared (NDIR) technology with an accuracy of plus or minus 50 ppm and a maximum response time of 1 minute. The sensor must be rated for operation at ambient air temperatures within the range of 32 to 122 degrees F and relative humidity within the range of 20 to 95 percent (non-condensing). The sensor must have a maximum drift of 2 percent per year. The sensor chamber must be manufactured with a non-corrosive material that does not affect carbon dioxide sample concentration. Duct mounted sensors must be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. The sensor must have a calibration interval no less than 5 years.

2.6.10 Floor Mounted Leak Detector

Leak detectors must use electrodes mounted at slab level with a minimum built-in-vertical adjustment of 0.125 inches. Detector must have a binary output. The indicator must be manual reset type.

2.6.11 Temperature Switch

2.6.11.1 Duct Mount Temperature Low Limit Safety Switch (Freezestat)

Duct mount temperature low limit switches (Freezestats) must be manual reset, low temperature safety switches at least 1 foot long per square foot of coverage which must respond to the coldest 18 inch segment with an accuracy of plus or minus 3.6 degrees F. The switch must have a field-adjustable setpoint with a range of at least 30 to 50 degrees F. The switch must have two sets of contacts, and each contact must have a rating greater than its connected load. Contacts must open or close upon drop of temperature below setpoint as indicated and must remain in this state until reset.

2.6.11.2 Pipe Mount Temperature Limit Switch (AquaStat)

Pipe mount temperature limit switches (aquastats) must have a field adjustable setpoint between 60 and 90 degrees F, an accuracy of plus or minus 3.6 degrees F and a 10 degrees F fixed deadband. The switch must have two sets of contacts, and each contact must have a rating greater than its connected load. Contacts must open or close upon change of temperature above or below setpoint as indicated.

2.6.12 Damper End Switches

Each end switch must be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure must be suitable for mounting on the duct exterior and must permit setting the position of the trip lever that actuates the switch. The trip lever must be aligned with the damper blade.

End switches integral to an electric damper actuator are allowed as long as at least one is adjustable over the travel of the actuator.

2.7 OUTPUT DEVICES

2.7.1 Actuators

Actuators must be electric (electronic). All actuators must be normally open (NO), normally closed (NC) or fail-in-last-position (FILP) as indicated. Normally open and normally closed actuators must be of mechanical spring return type. Electric actuators must have an electronic cut off or other means to provide burnout protection if stalled. Actuators must have a visible position indicator. Electric actuators must provide position feedback to the controller as indicated. Actuators must smoothly and fully open or close the devices to which they are applied. Electric actuators must have a full stroke response time in both directions of 90 seconds or less at rated load. Electric actuators must be of the foot-mounted type with an oil-immersed gear train or the direct-coupled type. Where multiple electric actuators operate from a common signal, the actuators must provide an output signal identical to its input signal to the additional devices. All actuators must be rated for their operating environment. Actuators used outdoors must be designed and rated for outdoor use. Actuators under continuous exposure to water, such as those used in sumps, must be submersible.

Actuators incorporating an integral network connection are considered DDC Hardware and must meet the DDC Hardware requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

2.7.1.1 Valve Actuators

Valve actuators must provide shutoff pressures and torques as indicated on the Valve Schedule.

2.7.1.2 Damper Actuators

Damper actuators must provide the torque necessary per damper manufacturer's instructions to modulate the dampers smoothly over its full range of operation and torque must be at least 6 inch-pounds/1 square foot of damper area for opposed blade dampers and 9 inch-pounds/1 square foot of damper area for parallel blade dampers.

2.7.1.3 Electric Actuators

Each actuator must have distinct markings indicating the full-open and full-closed position. Each actuator must deliver the torque required for continuous uniform motion and must have internal end switches to limit the travel, or be capable of withstanding continuous stalling without damage. Actuators must function properly within 85 to 110 percent of rated line voltage. Provide actuators with hardened steel running shafts and gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torques less than 16 inch-pounds.

- a. Two-position actuators must be single direction, spring return, or reversing type. Two position actuator signals may either be the control power voltage or line voltage as needed for torque or appropriate interlock circuits.
- b. Modulating actuators must be capable of stopping at any point in the cycle, and starting in either direction from any point. Actuators must be equipped with a switch for reversing direction, and a button to disengage the clutch to allow manual adjustments. Provide the actuator with a hand crank for manual adjustments, as applicable. Modulating actuator input signals can either be a 4 to 20 mAdc or a 0-10 VDC signal.
- c. Floating or pulse width modulation actuators are acceptable for non-fail safe applications unless indicated otherwise provided that the floating point control (timed actuation) must have a scheduled re-calibration of span and position no more than once a day and no less than once a week. The schedule for the re-calibration should not affect occupied conditions and be staggered between equipment to prevent falsely loading or unloading central plant equipment.

2.7.2 Relays

Relays must have contacts rated for the intended application, indicator light, and dust proof enclosure. The indicator light must be lit when the coil is energized and off when coil is not energized.

Control relay contacts must have utilization category and ratings selected for the application. Each set of contacts must incorporate a normally open (NO), normally closed (NC) and common contact. Relays must be rated for a minimum life of one million operations.

2.8 USER INPUT DEVICES

User Input Devices, including potentiometers, switches and momentary contact push-buttons. Potentiometers must be of the thumb wheel or sliding bar type. Momentary Contact Push-Buttons may include an adjustable timer for their output. User input devices must be labeled for their function.

2.9 MULTIFUNCTION DEVICES

Multifunction devices are products which combine the functions of multiple sensor, user input or output devices into a single product. Unless otherwise specified, the multifunction device must meet all requirements of each component device. Where the requirements for the component devices conflict, the multifunction device must meet the most stringent of the requirements.

2.9.1 Current Sensing Relay Command Switch

The Current Sensing Relay portion must meet all requirements of the Current Sensing Relay input device. The Command Switch portion must meet all requirements of the Relay output device except that it must have at least one normally-open (NO) contact.

Current Sensing Relays used for Variable Frequency Drives must be rated for Variable Frequency applications unless installed on the source side of the drive. If used in this situation, the threshold for showing status must be set to allow for the VFD's control power when the drive is not enabled and provide indication of operation when the drive is enabled at minimum speed.

2.9.2 Space Sensor Module

Space Sensor Modules must be multifunction devices incorporating a temperature sensor and one or more of the following as specified and indicated on the Space Sensor Module Schedule:

- a. A temperature indicating device.
- b. A User Input Device which must adjust a temperature setpoint output.
- c. A User Input Momentary Contact Button and an output to the control system indicating zone occupancy.
- d. A three position User Input Switch labeled to indicate heating, cooling and off positions ('HEAT-COOL-OFF' switch) and providing corresponding outputs to the control system.
- e. A two position User Input Switch labeled with 'AUTO' and 'ON' positions and providing corresponding output to the control system..
- f. A multi-position User Input Switch with 'OFF' and at least two fan speed positions and providing corresponding outputs to the control system.

Space Sensor Modules cannot contain mercury (Hg).

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General Installation Requirements

Perform the installation under the supervision of competent technicians regularly employed in the installation of DDC systems.

3.1.1.1 Device Mounting Criteria

All devices must be installed in accordance with manufacturer's recommendations and as specified and indicated. Control devices to be installed in piping and ductwork must be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements must not be used except as specified. Spare thermowells must be installed adjacent to each thermowell containing a

sensor and as indicated. Devices located outdoors must have a weathershield.

3.1.1.2 Labels and Tags

Match labels and tags to the unique identifiers indicated on the As-Built drawings. Label all enclosures and instrumentation. Tag all sensors and actuators in mechanical rooms. Tag airflow measurement arrays to show flow rate range for signal output range, duct size, and pitot tube AFMA flow coefficient. Tag duct static pressure taps at the location of the pressure tap. Provide plastic or metal tags, mechanically attached directly to each device or attached by a metal chain or wire. Labels exterior to protective enclosures must be engraved plastic and mechanically attached to the enclosure or instrumentation. Labels inside protective enclosures may be attached using adhesive, but must not be hand written.

3.1.2 Weathershield

Provide weathershields for sensors located outdoors. Install weathershields such that they prevent the sun from directly striking the sensor and prevent rain from directly striking or dripping onto the sensor. Install weather shields with adequate ventilation so that the sensing element responds to the ambient conditions of the surroundings. When installing weathershields near outside air intake ducts, install them such that normal outside air flow does not cause rainwater to strike the sensor.

3.1.3 Room Instrument Mounting

Mount room instruments, including but not limited to wall mounted non-adjustable space sensor modules and sensors located in occupied spaces, 48 inches above the floor unless otherwise indicated. Install adjustable devices to be ADA compliant.

3.1.4 Indication Devices Installed in Piping and Liquid Systems

Provide snubbers for gauges in piping systems subject to pulsation. For gauges for steam service use pigtail fittings with cock. Install thermometers and temperature sensing elements in liquid systems in thermowells. Provide spare Pressure/Temperature Ports (Pete's Plug) for all temperature and pressure sensing elements installed in liquid systems for calibration/testing.

3.1.5 Occupancy Sensors

Provide a sufficient quantity of occupancy sensors to provide complete coverage of the area (room or space). Occupancy sensors are to be ceiling mounted. Install occupancy sensors in accordance with NFPA 70 requirements and the manufacturer's instructions. Do not locate occupancy sensors within 6 feet of HVAC outlets or heating ducts, or where they can "see" beyond any doorway. Installation above doorway(s) is preferred. Do not use ultrasonic sensors in spaces containing ceiling fans. Install sensors to detect motion to within 2 feet of all room entrances and to not trigger due to motion outside the room. Set the off-delay timer to 15 minutes unless otherwise indicated. Adjust sensors prior to beneficial occupancy, but after installation of furniture systems, shelving, partitions, etc. For each controlled area, provide one hundred percent coverage capable of detecting small hand-motion movements, accommodating

all occupancy habits of single or multiple occupants at any location within the controlled room.

3.1.6 Switches

3.1.6.1 Temperature Limit Switch

Provide a temperature limit switch (freezestat) to sense the temperature at the location indicated. Provide a sufficient number of temperature limit switches (freezestats) to provide complete coverage of the duct section but no less than 1 foot in length per square foot of cross sectional area. Install manual reset limit switches in approved, accessible locations where they can be reset easily. Install temperature limit switch (freezestat) sensing elements in a side-to-side (not top-to-bottom) serpentine pattern with the relay section at the highest point and in accordance with the manufacturer's installation instructions.

3.1.6.2 Hand-Off Auto Switches

Wire safety controls such as smoke detectors and freeze protection thermostats to protect the equipment during both hand and auto operation.

3.1.7 Temperature Sensors

Install temperature sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate and install sensors according to manufacturer's instructions. Select sensors only for intended application as designated or recommended by manufacturer.

3.1.7.1 Room Temperature Sensors

Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of all user-adjustable sensors 48 inches above the floor to meet ABA requirements. Non user-adjustable sensors can be mounted as indicated in paragraph ROOM INSTRUMENT MOUNTING.

3.1.7.2 Duct Temperature Sensors

3.1.7.2.1 Probe Type

Place tip of the sensor in the middle of the airstream or in accordance with manufacturer's recommendations or instructions. Provide a gasket between the sensor housing and the duct wall. Seal the duct penetration air tight. When installed in insulated duct, provide enclosure or stand off fitting to accommodate the thickness of duct insulation to allow for maintenance or replacement of the sensor and wiring terminations. Seal the duct insulation penetration vapor tight.

3.1.7.2.2 Averaging Type

Weave the sensing element in a serpentine fashion from side to side perpendicular to the flow, across the duct or air handler cross-section, using durable non-metal supports in accordance with manufacturer's installation instructions. Avoid tight radius bends or kinking of the sensing element. Prevent contact between the sensing element and the duct or air handler internals. Provide a duct access door at the sensor

location. The access door must be hinged on the side, factory insulated, have cam type locks, and be as large as the duct will permit, maximum 18 by 18 inches. For sensors inside air handlers, the sensors must be fully accessible through the air handler's access doors without removing any of the air handler's internals.

3.1.7.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring piping, tank, or pressure vessel temperatures. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. When installed on insulated piping, provide stand enclosure or stand off fitting to accommodate the thickness of the pipe insulation and allow for maintenance or replacement of the sensor or wiring terminations. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells must not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide the sensor well with a heat-sensitive transfer agent between the sensor and the well interior ensuring contact between the sensor and the well.

3.1.7.4 Outside Air Temperature Sensors

Provide outside air temperature sensors on the building's north side with a protective weather shade that does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain. Location must not be near exhaust hoods and other areas such that it is not influenced by radiation or convection sources which may affect the reading. Provide a shield to shade the sensor from direct sunlight.

3.1.8 Air Flow Measurement Arrays (AFMA)

Locate Outside Air AFMAs downstream from the Outside Air filters.

Install AFMAs with the manufacturer's recommended minimum distances between upstream and downstream disturbances. Airflow straighteners may be used to reduce minimum distances as recommended by the AFMA manufacturer.

3.1.9 Duct Static Pressure Sensors

Locate the duct static pressure sensing tap at 75 percent of the distance between the first and last air terminal units as indicated on the design documents. If the transmitter output is a 0-10Vdc signal, locate the transmitter in the same enclosure as the air handling unit (AHU) controller for the AHU serving the terminal units. If a remote duct static pressure sensor is to be used, run the signal wire back to the controller for the air handling unit.

3.1.10 Relative Humidity Sensors

Install relative humidity sensors in supply air ducts at least 10 feet downstream of humidity injection elements.

3.1.11 Meters

3.1.11.1 Flowmeters

Install flowmeters to ensure minimum straight unobstructed piping for at

least 10 pipe diameters upstream and at least 5 pipe diameters downstream of the flowmeter, and in accordance with the manufacturer's installation instructions.

3.1.11.2 Energy Meters

Locate energy meters as indicated. Connect each meter output to the DDC system, to measure both instantaneous demand/energy and other variables as indicated.

3.1.12 Dampers

3.1.12.1 Damper Actuators

Provide spring return actuators which fail to a position that protects the served equipment and space on all control dampers related to freeze protection or force protection. For all outside, makeup and relief dampers provide dampers which fail closed. Terminal fan coil units, terminal VAV units, convectors, and unit heaters may be non-spring return unless indicated otherwise. Do not mount actuators in the air stream. Do not connect multiple actuators to a common drive shaft. Install actuators so that their action seal the damper to the extent required to maintain leakage at or below the specified rate and so that they move the blades smoothly throughout the full range of motion.

3.1.12.2 Damper Installation

Install dampers straight and true, level in all planes, and square in all dimensions. Dampers must move freely without undue stress due to twisting, racking (parallelogramming), bowing, or other installation error. External linkages must operate smoothly over the entire range of motion, without deformation or slipping of any connecting rods, joints or brackets that will prevent a return to its normal position. Blades must close completely and leakage must not exceed that specified at the rated static pressure. Provide structural support for multi-section dampers. Acceptable methods of structural support include but are not limited to U-channel, angle iron, corner angles and bolts, bent galvanized steel stiffeners, sleeve attachments, braces, and building structure. Where multi-section dampers are installed in ducts or sleeves, they must not sag due to lack of support. Do not use jackshafts to link more than three damper sections. Do not use blade to blade linkages. Install outside and return air dampers such that their blades direct their respective air streams towards each other to provide for maximum mixing of air streams.

3.1.13 Valves

Install the valves in accordance with the manufacturer's instructions.

3.1.13.1 Valve Actuators

Provide spring return actuators on all control valves where freeze protection is required. Spring return actuators for terminal fan coil units, terminal VAV units, convectors, and unit heaters are not required unless indicated otherwise.

3.1.14 Thermometers

3.1.14.1 Thermometers

Mount devices to allow reading while standing on the floor or ground, as applicable.

3.1.15 Wire and Cable

Provide complete electrical wiring for the Control System, including wiring to transformer primaries. Wire and Cable must be installed without splices between control devices and in accordance with NFPA 70 and NFPA 90A. Instrumentation grounding must be installed per the device manufacturer's instructions and as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system. Test installed ground rods as specified in IEEE 142. Cables and conductor wires must be tagged at both ends, with the identifier indicated on the shop drawings. Electrical work must be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and as indicated. Wiring external to enclosures must be run in raceways, except low-voltage control and low-voltage network wiring may be installed as follows:

- a. plenum rated cable in suspended ceilings over occupied spaces may be run without raceways
- b. nonmetallic-sheathed cables or metallic-armored cables may be installed as permitted by NFPA 70.

Install control circuit wiring not in raceways in a neat and safe manner. Wiring must not use the suspended ceiling system (including tiles, frames or hangers) for support. Where conduit or raceways are required, control circuit wiring must not run in the same conduit/raceway as power wiring over 50 volts. Run all circuits over 50 volts in conduit, metallic tubing, covered metal raceways, or armored cable.

-- End of Section --

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SECTION 23 09 23.02

BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS
02/19, CHG 1: 02/20

PART 1 GENERAL

1.1 SUMMARY

Provide a complete Direct Digital Control (DDC) system, except for the front end which is specified in Section 25 05 11.01 CYBERSECURITY FOR BUILDING AUTOMATION SYSTEM, suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as specified and shown and in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.1.1 System Requirements

Provide a system meeting the requirements of both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section and with the following characteristics:

- a. Except for Gateways, the control system must be an open implementation of BACnet technology using ASHRAE 135 as the communications protocol. The system must use standard ASHRAE 135 Objects and Properties. The system must use standard ASHRAE 135 Services exclusively for communication over the network. Gateways to packaged units must communicate with other DDC hardware using ASHRAE 135 exclusively and may communicate with packaged equipment using other protocols. The control system must be installed such that any two devices on the Internetwork can communicate using standard ASHRAE 135 Services.
- b. Install and configure control hardware to provide ASHRAE 135 Objects and Properties as indicated and as needed to meet the requirements of this specification.

1.1.2 Verification of Specification Requirements

Review all specifications related to the control system installation and advise the Contracting Officer of any discrepancies before performing any work. If Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC or any other Section referenced in this specification is not included in the project specifications advise the Contracting Officer and either obtain the missing Section or obtain Contracting Officer approval before performing any work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 135

(2016) BACnet-A Data Communication
Protocol for Building Automation and
Control Networks

BACNET INTERNATIONAL (BTL)

BTL Guide (v.49; 2017) BACnet Testing Laboratory
Implementation Guidelines

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3 (2018) Ethernet

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-485 (1998a; R 2012) Electrical Characteristics
of Generators and Receivers for Use in
Balanced Digital Multipoint Systems

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15 Radio Frequency Devices (47 CFR 15)

UNDERWRITERS LABORATORIES (UL)

UL 916 (2015) Standard for Energy Management
Equipment

1.3 DEFINITIONS

For definitions related to this section, see Section 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC.

1.4 SUBMITTALS

Submittal requirements related to this Section are specified in Section
23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

PART 2 PRODUCTS

All products used to meet this specification must meet the indicated
requirements, but not all products specified here will be required by
every project. All products must meet the requirements both Section
23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section.

2.1 NETWORK HARDWARE

2.1.1 BACnet Router

All BACnet Routers must be BACnet/IP Routers and must perform layer 3
routing of ASHRAE 135 packets over an IP network in accordance with
ASHRAE 135 Annex J and Clause 6. The router must provide the appropriate
connection to the IP network and connections to one or more ASHRAE 135
MS/TP networks. Devices used as BACnet Routers must meet the
requirements for DDC Hardware, and must support the NM-RC-B BIBB.

2.1.2 BACnet Gateways

In addition to the requirements for DDC Hardware, the BACnet Gateway must
meet the following requirements:

- a. It must perform bi-directional protocol translation from one non-

ASHRAE 135 protocol to ASHRAE 135. BACnet Gateways must incorporate a network connection to an ASHRAE 135 network (either BACnet over IP in accordance with Annex J or MS/TP) and a separate connection appropriate for the non-ASHRAE 135 protocol and media.

- b. It must retain its configuration after a power loss of an indefinite time, and must automatically return to their pre-power loss state once power is restored.
- c. It must allow bi-directional mapping of data between the non-ASHRAE 135 protocol and Standard Objects as defined in ASHRAE 135. It must support the DS-RP-B BIBB for Objects requiring read access and the DS-WP-B BIBB for Objects requiring write access.
- d. It must support the DS-COV-B BIBB.

Although Gateways must meet DDC Hardware requirements they are not DDC Hardware and must not be used when DDC Hardware is required.

2.1.3 Ethernet Switch

Ethernet Switches must be managed switches and must autoconfigure between 10,100 and 1000 megabits per second (MBPS).

2.2 CONTROL NETWORK WIRING

- a. BACnet MS/TP communications wiring must be in accordance with ASHRAE 135. The wiring must use shielded, three wire (twisted-pair with reference) cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors must be less than 30 pF per foot.
- b. Building Control Network Backbone IP Network must use Ethernet media. Ethernet cables must be CAT-6 at a minimum and meet all requirements of IEEE 802.3.

2.3 DIRECT DIGITAL CONTROL (DDC) HARDWARE

2.3.1 General Requirements

All DDC Hardware must meet the following requirements:

- a. It must be locally powered and must incorporate a light to indicate the device is receiving power.
- b. It must conform to the BTL Guide.
- c. It must be BACnet Testing Laboratory (BTL) Listed.
- d. The Manufacturer's Product Data submittal for each piece of DDC Hardware must include the Protocol Implementation Conformance Statement (PICS) for that hardware as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.
- e. It must communicate and be interoperable in accordance with ASHRAE 135 and have connections for BACnet IP or MS/TP control network wiring.
- f. Other than devices controlling terminal units or functioning solely as a BACnet Router, it must support DS-COV-B, DS-RPM-A and DS-RPM-B BIBBs.

- g. Devices supporting the DS-RP-A BIBB must also support the DS-COV-A BIBB.
- h. Application programs, configuration settings and communication information must be stored in a manner such that they persist through loss of power:
 - (1) Application programs must persist regardless of the length of time power is lost.
 - (2) Configured settings must persist for any loss of power less than 2,500 hours.
 - (3) Communication information, including but not limited to COV subscriptions, event reporting destinations, Notification Class Object settings, and internal communication settings, must persist for any loss of power less than 2,500 hours.
- i. Internal Clocks:
 - (1) Clocks in DDC Hardware incorporating a Clock must continue to function for 120 hours upon loss of power to the DDC Hardware.
 - (2) DDC Hardware incorporating a Clock must support the DM-TS-B or DM-UTC-B BIBB.
- j. It must have all functionality indicated and required to support the application (Sequence of Operation or portion thereof) in which it is used, including but not limited to providing Objects as specified and as indicated on the Points Schedule.
- k. In addition to these general requirements and the DDC Hardware Input-Output (I/O) Function requirements, all DDC Hardware must also meet any additional requirements for the application in which it is used (e.g. scheduling, alarming, trending, etc.).
- l. It must meet FCC Part 15 requirements and have UL 916 or equivalent safety listing.
- m. Device must support Commandable Objects to support Override requirements as detailed in PART 3 EXECUTION
- n. User interfaces which allow for modification of Properties or settings must be password-protected.
- o. Devices communicating BACnet MS/TP must meet the following requirements:
 - (1) Must have a configurable Max_Master Property.
 - (2) DDC Hardware other than hardware controlling a single terminal unit must have a configurable Max_Info_Frames Property.
 - (3) Must respond to any valid request within 50 msec with either the appropriate response or with a response of "Reply Postponed".
 - (4) Must use twisted pair with reference and shield (3-wire media) wiring, or twisted pair with shield (2-wire media) wiring and use

half-wave rectification.

- p. Devices communicating BACnet/IP must use UDP Port 0xBAC0. Devices with configurable UDP Ports must default to 0xBAC0.
- q. All Device IDs, Network Numbers, and BACnet MAC addresses of devices must be fully configurable without limitation, except MS/TP MAC addresses may be limited by ASHRAE 135 requirements.
- r. DDC Hardware controlling a single terminal unit must have:
 - (1) Objects (including the Device Object) with an Object Name Property of at least 8 characters in length.
 - (2) A configurable Device Object Name.
 - (3) A configurable Device Object Description Property at least 16 characters in length.
- s. Except for Objects in DDC Hardware controlling a single terminal unit, all Objects (including Device Objects) must:
 - (1) Have a configurable Object Name Property of at least 12 characters in length.
 - (2) Have a configurable Object Description Property of at least 24 characters in length.
- t. For programmable DDC Hardware, provide and license to the project site all programming software required to program the Hardware in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.
- u. For programmable DDC Hardware, provide copies of the installed application programs (all software that is not common to every controller of the same manufacturer and model) as source code compatible with the supplied programming software in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. The submitted application program must be the complete application necessary for controller to function as installed and be sufficient to allow replacement of the installed controller with another controller of the same type.

2.3.2 Hardware Input-Output (I/O) Functions

DDC Hardware incorporating hardware input-output (I/O) functions must meet the following requirements:

2.3.2.1 Analog Inputs

DC Hardware analog inputs (AIs) must be implemented using ASHRAE 135 Analog Input Objects and perform analog to digital (A-to-D) conversion with a minimum resolution of 8 bits plus sign or better as needed to meet the accuracy requirements specified in Section 23 09 00. Signal conditioning including transient rejection must be provided for each analog input. Analog inputs must be capable of being individually calibrated for zero and span. Calibration via software scaling performed as part of point configuration is acceptable. The AI must incorporate common mode noise rejection of at least 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of at least 20 dB at

60 Hz from a source impedance of 10,000 ohms.

2.3.2.2 Analog Outputs

DDC Hardware analog outputs (AOs) must be implemented using ASHRAE 135 Analog Output Objects and perform digital to analog (D-to-A) conversion with a minimum resolution of 8 bits plus sign, and output a signal with a range of 4-20 mA_{dc} or 0-10 V_{dc}. Analog outputs must be capable of being individually calibrated for zero and span. Calibration via software scaling performed as part of point configuration is acceptable. DDC Hardware with Hand-Off-Auto (H-O-A) switches for analog outputs must provide for overriding the output through the range of 0 percent to 100 percent

2.3.2.3 Binary Inputs

DDC Hardware binary inputs (BIs) must be implemented using ASHRAE 135 Binary Input Objects and accept contact closures and must ignore transients of less than 5 milli-second duration. Protection against a transient 50VAC must be provided.

2.3.2.4 Binary Outputs

DDC Hardware binary outputs (BOs) must be implemented using ASHRAE 135 Binary Output Objects and provide relay contact closures or triac outputs for momentary and maintained operation of output devices. DDC Hardware with H-O-A switches for binary outputs must provide for overriding the output open or closed.

2.3.2.4.1 Relay Contact Closures

Closures must have a minimum duration of 0.1 second. Relays must provide at least 180V of isolation. Electromagnetic interference suppression must be provided on all output lines to limit transients to 50 Vac. Minimum contact rating must be 0.5 amperes at 24 Vac.

2.3.2.4.2 Triac Outputs

Triac outputs must provide at least 180 V of isolation. Minimum contact rating must be 0.5 amperes at 24 Vac.

2.3.2.5 Pulse Accumulator

DDC Hardware pulse accumulators must be implemented using either an ASHRAE 135 Accumulator Object or an ASHRAE 135 Analog Value Object where the Present_Value is the totalized pulse count. Pulse accumulators must accept contact closures, ignore transients less than 5 msec duration, protect against transients of 50 VAC, and accept rates of at least 20 pulses per second.

2.3.2.6 ASHRAE 135 Objects for Hardware Inputs and Outputs

The requirements for use of ASHRAE 135 objects for hardware input and outputs includes devices where the hardware sensor or actuator is integral to the controller (e.g. a VAV box with integral damper actuator, a smart sensor, a VFD, etc.)

2.3.2.7 Integrated H-O-A Switches

Where integrated H-O-A switches are provided on hardware outputs, controller must provide means of monitoring position or status of H-O-A switch. This feedback may be provided via any valid BACnet method, including the use of proprietary Objects, Properties, or Services.

2.3.3 Local Display Panel (LDP)

The Local Display Panels (LDPs) must be DDC Hardware with a display and navigation buttons or a touch screen display, and must provide display and adjustment of ASHRAE 135 Properties as indicated on the Points Schedule and as specified. LDPs must be either BTL Listed as a B-OD, B-OWS, B-AWS, or be an integral part of another piece of DDC Hardware listed as a B-BC. For LDPs listed as B-OWS or B-AWS, the hardware must be BTL listed and the product must come factory installed with all applications necessary for the device to function as an LDP.

The adjustment of values using display and navigation buttons must be password protected.

2.3.4 Expansion Modules and Tethered Hardware

A single piece of DDC Hardware may consist of a base unit and also:

- a. An unlimited number of hardware expansion modules, where the individual hardware expansion modules are designed to directly connect, both mechanically and electrically, to the base unit hardware. The expansion modules must be commercially available as an optional add-on to the base unit.
- b. A single piece of hardware connected (tethered) to a base unit by a single cable where the cable carries a proprietary protocol between the base unit and tethered hardware. The tethered hardware must not contain control logic and be commercially available as an optional add-on to the base unit as a single package.

Note that this restriction on tethered hardware does not apply to sensors or actuators using standard binary or analog signals (not a communications protocol); sensors or actuators using standard binary or analog signals are not considered part of the DDC Hardware.

Hardware capable of being installed stand-alone, or without a separate base unit, is DDC Hardware and must not be used as expansion modules or tethered hardware.

2.3.5 Supervisory Control Requirements

2.3.5.1 Scheduling Hardware

DDC Hardware used for scheduling must meet the following requirements:

- a. It must be BTL Listed as a B-BC and support the SCHED-E-B BIBB.
- b. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Calendar and Schedule Objects, such that a front end BTL listed as a B-AWS may create or delete Calendar and Schedule Objects. It is also preferred but not required that devices supporting the DM-OCD-B BIBB accept any valid value for properties of Calendar and

Schedule Objects. Note that there are additional requirements in the EXECUTION Part of this Section for Devices which do not support the DM-OCD-B BIBB as specified.

- c. The Date_List property of all Calendar Objects must be writable.
- d. The Present_Value Property of Schedule must support the following values: 1, 2, 3, 4.

2.3.5.2 Alarm Generation Hardware

DDC Hardware used for alarm generation must meet the following requirements:

- a. Device must support the AE-N-I-B BIBB
- b. The Recipient_List Property must be Writable for all Notification Class Objects used for alarm generation.
- c. For all Objects implementing Intrinsic Alarming, the following Properties must be Writable:
 - (1) Time_Delay
 - (2) High_Limit
 - (3) Low_Limit
 - (4) Deadband
 - (5) Event_Enable
 - (6) If the issue date of this project specification is after 1 January 2016, Time_Delay_Normal must be writable.
- d. For Event Enrollment Objects used for alarm generation, the following Properties must be Writable:
 - (1) Event_Parameters
 - (2) Event_Enable
 - (3) If the issue date of this project specification is after 1 January 2016, Time_Delay_Normal must be writable.
- e. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Notification Class Objects and Event Enrollment Objects, such that a front end BTL listed as a B-AWS may create or delete Notification Class Objects and Event Enrollment Objects. It is also preferred, but not required that devices supporting the DM-OCD-B BIBB accept any valid value as an initial value for properties of Notification Class Objects and Event Enrollment Objects. Note that there are additional requirements in the EXECUTION Part of this Section for devices which do not support the DM-OCD-B BIBB as specified.
- f. Devices provided to meet the the requirements indicated under "Support for Future Alarm Generation" in the EXECUTION part of this specification must support the AE-N-E-B BIBB.

2.3.5.3 Trending Hardware

DDC Hardware used for collecting trend data must meet the following requirements:

- a. Device must support Trend Log or Trend Log Multiple Objects.

- b. Device must support the T-VMT-I-B BIBB.
- c. Devices provided to meet the EXECUTION requirement for support of Future Trending must support the T-VMT-E-B BIBB.
- d. The following properties of all Trend Log or Trend Log Multiple Objects must be present and Writable:
 - Start_Time
 - Stop_Time
 - Log_DeviceObjectProperty
 - Log Interval Log interval must support an interval of at least 60 minutes duration.
- e. Trend Log Objects must support using Intrinsic Reporting to send a BUFFER_FULL event.
- f. The device must have a Notification Class Object for the BUFFER_FULL event. The Recipient_List Property must be Writable.
- g. Devices must support values of at least 1,000 for Buffer_Size Properties.
- h. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Trend Log Objects, such that a front end BTL listed as a A-AWS may create or delete Trend Log Objects. It is also preferred, but not required that devices supporting the DM-OCD-B BIBB accept any valid value as an initial value for properties of Trend Log Objects. Note that there are additional EXECUTION requirements for devices which do not support the DM-OCD-B BIBB as specified.

PART 3 EXECUTION

3.1 CONTROL SYSTEM INSTALLATION

3.1.1 Building Control Network (BCN)

Install the Building Control Network (BCN) as a single BACnet Internetwork consisting of a single IP network as the BCN Backbone and zero or more BACnet MS/TP networks. Note that in some cases there may only be a single device on the BCN Backbone.

Except as permitted for the non-BACnet side of Gateways, use exclusively ASHRAE 135 networks.

3.1.1.1 Building Control Network IP Backbone

Install IP Network Cabling in conduit. Install Ethernet Switches in lockable enclosures. Install the Building Control Network (BCN) IP Backbone such that it is available at the Facility Point of Connection (FPOC) location as indicated. When the FPOC location is a room number, provide sufficient additional media to ensure that the Building Control Network (BCN) IP Backbone can be extended to any location in the room.

Use UDP port 0xBAC0 for all BACnet traffic on the IP network.

3.1.1.2 BACnet MS/TP Networks

When using MS/TP, provide MS/TP networks in accordance with ASHRAE 135 and

in accordance with the ASHRAE 135 figure "Mixed Devices on 3-Conductor Cable with Shield" (Figure 9-1.4 in the 2012 version of ASHRAE 135). Ground the shield at the BACnet Router and at no other point. Ground the reference wire at the BACnet Router through a 100 ohm resistor and do not ground it at any other point. In addition:

- a. Provide each segment in a doubly terminated bus topology in accordance with TIA-485.
- b. Provide each segment with 2 sets of network bias resistors in accordance with ASHRAE 135, with one set of resistors at each end of the MS/TP network.
- c. Use 3 wire (twisted pair and reference) with shield media for all MS/TP media installed inside. Use fiber optic isolation in accordance with ASHRAE 135 for all MS/TP media installed outside buildings, or between multiple buildings.
- d. For 18 AWG cable, use segments with a maximum length of 4000 ft. When using greater distances or different wire gauges comply with the electrical specifications of TIA-485.
- e. For each controller that does not use the reference wire provide transient suppression at the network connection of the controller if the controller itself does not incorporate transient suppression.
- f. Install no more than 32 devices on each MS/TP segment. Do not use MS/TP to MS/TP routers.
- g. Connect each MS/TP network to the BCN backbone via a BACnet Router.
- h. For BACnet Routers, configure the MS/TP MAC address to 0. Assign MAC Addresses to other devices consecutively beginning at 1, with no gaps.
- i. Configure the Max_Master Property of all devices to be 31.

3.1.1.3 Building Control Network (BCN) Installation

Provide a building control network meeting the following requirements:

- a. Install all DDC Hardware connected to the Building Control Network.
- b. Where multiple pieces of DDC Hardware are used to execute one sequence, install all DDC Hardware executing that sequence on a single MS/TP network dedicated to that sequence.
- c. Traffic between BACnet networks must be exclusively via BACnet routers.

3.1.2 DDC Hardware

Install all DDC Hardware that connects to an IP network in lockable enclosure. Install other DDC Hardware that is not in suspended ceilings in lockable enclosures. For all DDC hardware with a user interface, coordinate with site to determine proper passwords and configure passwords into device.

- a. Except for zone sensors (thermostats), install all Tethered Hardware within 6 feet of its base unit.

- b. Install and configure all BTL-Listed devices in a manner consistent with their BTL Listing such that the device as provided still meets all requirements necessary for its BTL Listing.
- c. Install and configure all BTL-Listed devices in a manner consistent with the BTL Device Implementation Guidelines such that the device as provided meets all those Guidelines.

3.1.2.1 Device Identifiers, Network Addresses, and IP addresses

- a. Do not use any Device Identifier or Network Number already used by another BACnet system at the project site. Coordinate Device IDs and Network Numbers with the installation.

3.1.2.2 Object Name Property and Object Description Property

Configure the Object_Names and Object_Descriptions properties of all Objects (including Device Objects) as indicated on the Points Schedule (Point Name and Point Description) and as specified. At a minimum:

- a. Except for DDC Hardware controlling a single terminal unit, configure the Object_Name and Object_Description properties of all Objects (including Device Objects) as indicated on the Points Schedule and as specified.
- b. In DDC Hardware controlling a single terminal unit, configure the Device Object_Name and Device Object_Description as indicated on the Points Schedule and as specified.

When Points Schedule entries exceed the length limitations in the device, notify Contracting Officer and provide recommended alternatives for approval.

3.1.2.3 Hand-Off-Auto (H-O-A) Switches

Provide Hand-Off-Auto (H-O-A) switches for all DDC Hardware analog outputs and binary outputs used for control of systems other than terminal units, as specified and as indicated on the Points Schedule. Provide H-O-A switches that are integral to the controller hardware, an external device co-located with (in the same enclosure as) the controller, integral to the controlled equipment, or an external device co-located with (in the same enclosure as) the controlled equipment.

- a. For H-O-A switches integral to DDC Hardware, meet the requirements specified in paragraph DIRECT DIGITAL CONTROL (DDC) HARDWARE.
- b. For external H-O-A switches used for binary outputs, provide for overriding the output open or closed.
- c. For external H-O-A switches used for analog outputs, provide for overriding through the range of 0 percent to 100 percent.

3.1.2.4 Local Display Panels

Provide LDPs to display values of ASHRAE 135 Object Properties as indicated on the Points Schedule.

3.1.2.5 MS/TP Slave Devices

Configure all MS/TP devices as Master devices. Do not configure any devices to act as slave devices.

3.1.2.6 Change of Value (COV) and Read Property

- a. To the greatest extent possible, configure all devices to support the SubscribeCOV service (the DS-COV-B BIBB). At a minimum, all devices supporting the DS-RP-B BIBB, other than devices controlling only a single terminal unit, must be configured to support the DS-COV-B BIBB.
- b. Whenever supported by the server side, configure client devices to use the DS-COV-A BIBB.

3.1.2.7 Engineering Units

Configure devices to use English (Inch-Pound) engineering units as follows:

- a. Temperature in degrees F
- b. Air or natural gas flows in cubic feet per minute (CFM)
- c. Water in gallons per minute (GPM)
- d. Steam flow in pounds per hour (pph)
- e. Differential Air pressures in inches of water column (IWC)
- f. Water, steam, and natural gas pressures in PSI
- g. Enthalpy in BTU/lb
- h. Heating and cooling energy in MBTU (1MBTU = 1,000,000 BTU)
- i. Cooling load in tons (1 ton = 12,000 BTU/hour)
- j. Heating load in MBTU/hour (1MBTU = 1,000,000 BTU)
- k. Electrical Power: kilowatts (kW)
- l. Electrical Energy: kilowatt-hours (kWh)

3.1.2.8 Occupancy Modes

Use the following correspondence between value and occupancy mode whenever an occupancy state or value is required:

- a. OCCUPIED mode: a value of one
- b. UNOCCUPIED mode: a value of two
- c. WARM-UP/COOL-DOWN (PRE-OCCUPANCY) mode: a value of three

Note that elsewhere in this Section the Schedule Object is required to also support a value of four, which is reserved for future use. Also note that the behavior of a system in each of these occupancy modes is indicated in the sequence of operation for the system.

3.1.2.9 Use of BACnet Objects

Use only standard non-proprietary ASHRAE 135 Objects and services to accomplish the project scope of work as follows:

- a. Use Analog Input or Analog Output Objects for all analog hardware I/O. Do not use Analog Value Object for analog hardware I/O).
- b. Use Binary Input or Binary Output Objects for all binary hardware I/O. Do not use Binary Value Objects for binary hardware I/O.
- c. Use Analog Value Objects for analog setpoints.
- d. Use Accumulator Objects or Analog Value Objects for pulse inputs.
- e. For occupancy modes, use Multistate Value Objects and the correspondence between value and occupancy mode specified in paragraph OCCUPANCY MODES.
- f. Use Schedule Objects and Calendar Objects for all scheduling. Use Trend Log Objects or Trend Log Multiple Objects for all trending and Notification Class Objects for trend log upload. Use a combination of Event Enrollment Objects, Intrinsic Alarming, and Notification Class Objects for alarm generation.
- g. For all other points shown on the Points Schedule as requiring an ASHRAE 135 Object, use the Object type shown on the Points Schedule or, if no Object Type is shown, use a standard Object appropriate to the point.

3.1.2.10 Use of Standard BACnet Services

Except as noted in this paragraph, for all DDC Hardware use Standard BACnet Services as defined in this specification (which excludes some ASHRAE 135 services) exclusively for application control functionality and communication.

DDC Hardware that cannot meet this requirement may use non-standard services provided they can provide identical functionality using Standard BACnet Services when communicating with BACnet devices from a different vendor. When implementing non-standard services, document all non-standard services in the DDC Hardware Schedule as specified and as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

3.1.2.11 Device Application Configuration

- a. For every property, setting or value shown on the Points Schedule or otherwise indicated as Configurable, provide a value that is retained through loss of power and can be changed via one or more of:
 - (1) BACnet services (including proprietary services)
 - (2) Hardware settings on the device
- b. For every property, setting or value shown on the Points Schedule or otherwise indicated as Operator Configurable, provide a value that is retained through loss of power and can be changed via one or more of:
 - (1) A Writable Property of a standard BACnet Object

- (2) A Property of a standard BACnet Object that is Writable when Out_Of_Service is TRUE and Out_Of_Service is Writable.

3.1.3 Scheduling, Alarming, Trending, and Overrides

3.1.3.1 Scheduling

Configure schedules in BACnet Scheduling Objects to schedule systems as indicated on the Points Schedule and as specified using the indicated correspondence between value and occupancy mode. If no devices supports both the SCHED-E-B and DM-OCD-B BIBBS for Schedule Objects, provide 5 blank Schedule Objects in DDC Hardware BTL listed as B-BCs and supporting the SCHED-E-B BIBB for later use by the site.

Provide a separate schedule for each AHU including it's associated Terminal Units and for each stand-alone Terminal Unit (those not dependent upon AHU service) or group of stand-alone Terminal Units acting according to a common schedule.

3.1.3.2 Configuration of Alarm Generation

- a. Send alarm events as Alarms (not Events).
- b. Use the ConfirmedNotification Service for alarm events.
- c. For alarm generation, support two priority levels for alarms: critical and non-critical. Configure the Priority of Notification Class Objects to use Priority 112 for critical and 224 for non-critical alarms.
- d. Number of Notification Class Objects for Alarm Generation:
 - (1) If the device implements non-critical alarms, or if any Object in the device supports Intrinsic Alarms, then provide a single Notification Class Object specifically for (shared by) all non-critical alarms.
 - (2) If the device implements critical alarms, provide a single Notification Class Object specifically for (shared by) all critical alarms.
 - (3) If the device implements both critical and non-critical alarms, provide both Notification Class Objects (one for critical, one for non-critical).
 - (4) If the device controls equipment other than a single terminal unit, provide both Notification Class Objects (one for critical, one for non-critical) even if no alarm generation is required at time of installation.
- e. For all intrinsic alarms configure the Limit_Enable Property to set both HighLimitEnable and LowLimitEnable to TRUE. If the specified alarm conditions are for a single-sided alarm (only High_Limit used or only Low_Limit used) assign a value to the unused limit such that the unused alarm condition will not occur.
- f. For all objects supporting intrinsic alarming, even if no alarm generation is required during installation, configure the following

Properties as follows:

- (1) Notification_Class to point to the non-Critical Notification Class Object in that device.
- (2) Limit_Enable to enable both the HighLimitEnable and LowLimitEnable
- (3) Notify_Type to Alarm

g. Use of alarm generation types:

- (1) Only use algorithmic alarm generation when intrinsic alarm generation is not supported by the device or object, or when the specific alarm conditions cannot be implemented using intrinsic alarm generation.
- (2) Only use remote alarm generation when the alarm cannot be generated using intrinsic or local algorithmic alarm generation on the device containing the referenced property. If remote alarm generation is used, use the same DDC Hardware for all remote alarm generation within a single sequence.

3.1.3.3 Support for Future Alarm Generation

For every piece of DDC Hardware, support future alarm generation capabilities by supporting either intrinsic or additional algorithmic alarming. Provide one of the following:

- a. Support intrinsic alarming for every Object used by the application in that device.
- b. Support additional Event_Enrollment Objects. For DDC hardware controlling a single terminal unit, support at least one additional object. Otherwise, support at least 4 additional Objects. Support additional Event_Enrollment Objects via one of the following:
 - (1) Provide unused Event_Enrollment Objects on that device.
 - (2) Support the DM-OCD-B BIBB and the creation of sufficient Event_Enrollment Objects on that device.
 - (3) Provide one or more devices in the IP network that support the AE-N-E-B BIBB and have unused Event_Enrollment Objects.
 - (4) Provide one or more devices on the IP network that support the AE-N-E-B BIBB, the DM-OCD-B BIBB, and the creation of sufficient Event_Enrollment Objects.

The total number of Event_Enrollment Objects required by the project is the sum of the individual device requirements, and the distribution of Event_Enrollment Objects among devices is not further restricted. (Note this allows a single device to contain many Event_Enrollment Objects satisfying the requirements for multiple devices.)

3.1.3.4 Trend Log Configuration

- a. Configure trends in Trend Log or Trend Log Multiple Objects as indicated on the Points Schedule and as specified.

- b. Configure all trend logs (including any provided to support future trends) to save data on regular intervals using the BUFFER_FULL event to request trend upload from the front end.
- c. Configure Trend Log Objects with a minimum Buffer_Size property value of 1,000 and Trend Log Multiple Objects with a minimum Buffer_Size property value of 1,000 per point trended (for example, a Trend Log Multiple Object used to trend 3 points must have a Buffer_Size Property value of at least 3,000).
- d. Configure a Notification Class Object in devices doing trending (including devices supporting future trends) to handle the BUFFER_FULL event.
- e. When possible, trend each point using an Object in the device containing the point. When it is necessary to trend using a an Object in another device, all trends not on the same Device as the Object being trended must be on a single device (i.e. all Trend Log and Trend Log Multiple Objects used for remote trending within a sequence must be on the same device).
- f. For each trend log, including any trend logs provided to support future trending, configure the following properties as specified:
 - (1) Logging_Type: Set to Polling
 - (2) Stop_When_Full: Set to Wrap Around
 - (3) Buffer_Size: Set to 400 or greater.
 - (4) Notification_Threshold: Set to 90 percent of full
 - (5) Notification_Class: Set to the Notification Class Object in that device
 - (6) Event_Enable: Set to TRUE
 - (7) Log_Interval: Set to 15 minutes.

3.1.3.5 Overrides

Provide an override for each point shown on the Points Schedule as requiring an override.

Unless otherwise approved, provide Commandable Objects to support all Overrides. With specific approval from the contracting officer, Overrides for points which are not hardware outputs and which are in DDC hardware controlling a single terminal unit may support overrides via an additional Object provided for the override. No other means of implementing Overrides may be used.

- a. Where Commandable Objects are used, ensure that WriteProperty service requests with a Priority of 10 or less take precedence over the SEQUENCE VALUE and that WriteProperty service request with a priority of 11 or more have a lower precedence than the SEQUENCE VALUE.
- b. For devices implementing overrides via additional Objects, provide Objects which are NOT Written to as part of the normal Sequence of Operations and are Writable when Out_Of_Service is TRUE and

Out_Of_Service is Writable. Use this point as an Override of the normal value when Out_Of_Service is TRUE and the normal value otherwise. Note these Objects may be modified as part of the sequence via local processes, but must not be modified by local processes when Out_Of_Service is TRUE.

3.1.4 BACnet Gateways

The requirements in this paragraph do not themselves permit the installation of hardware not meeting the other requirements of this section. Except for proprietary systems specifically indicated in Section 23 09 00, all control hardware installed under this project must meet the requirements of this specification, including the control hardware providing the network interface for a package unit or split system specified under another section. Only use gateways to connect to pre-existing control devices, and to proprietary systems specifically permitted by Section 23 09 00.

3.1.4.1 General Gateway Requirements

Provide BACnet Gateways to connect non-BACnet control hardware in accordance with the following:

- a. Configure gateways to map writable data points in the controlled equipment to Writable Properties of Standard Objects as indicated in the Points Schedule and as specified.
- b. Configure gateway to map readable data points in the controlled equipment to Readable Properties of Standard Objects as indicated in the Points Schedule and as specified.
- c. Configure gateway to support the DS-COV-B BIBB for all points mapped to BACnet Objects.
- d. Do not use non-BACnet control hardware for controlling built-up units or any other equipment that was not furnished with factory-installed controls.
- e. Do not use non-BACnet control hardware for system scheduling functions.
- f. Each gateway must communicate with and perform protocol translation for non-BACnet control hardware controlling one and only one package unit or a single non-BACnet system specifically permitted by Section 23 09 00.
- g. Connect one network port on the gateway to the Building Control Backbone IP Network or to a BACnet MS/TP network and the other port to the single piece of controlled equipment or the non-BACnet system specifically permitted by Section 23 09 00.
- h. For gateways to existing package units or simple split systems, non-BACnet network wiring connecting the gateway to the package unit must not exceed 10 feet in length and must connect to exactly two devices: the controlled equipment (packaged unit) or split system interface and the gateway.

-- End of Section --

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SECTION 23 09 93

SEQUENCES OF OPERATION FOR HVAC CONTROL
11/15

PART 1 GENERAL

1.1 DEFINITIONS

For definitions related to this Section, see Section 23 09 00
INTRUMENTATION AND CONTROL FOR HVAC.

1.2 SUBMITTALS

Submittals related to this Section are specified in Section 23 09 00
INTRUMENTATION AND CONTROL FOR HVAC.

PART 2 PRODUCTS

Products related to this Section are specified in Section 23 09 00
INTRUMENTATION AND CONTROL FOR HVAC and related Sections 23 09 13
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC and 23 09 23.02 BACNET DIRECT
DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

PART 3 EXECUTION

3.1 SEQUENCES OF OPERATION FOR OCCUPANCY SCHEDULING

3.1.1 System Mode

Operate air handling units (AHUs) in Occupied, Warm-Up-Cool-Down, or
Unoccupied modes as specified. VAV boxes, Fan Coils, and operate other
terminal equipment in Occupied or Unoccupied modes as specified.
Chillers, boilers, and other sources of heating/cooling for hydronic loads
do not require scheduling; these systems receive requests for
heating/cooling from their loads.

3.1.2 System Scheduler Requirements

The System Scheduler functionality must reside in either a piece of DDC
Hardware dedicated to this functionality or in the DDC Hardware
controlling the system AHU. A single piece of DDC Hardware dedicated to
scheduling (performing no other control functionality) may contain
multiple System Schedulers. Provide a unique System Scheduler for: each
AHU including it's associated Terminal Units, and each stand-alone
Terminal Unit (those not dependent upon AHU service). Each System
Scheduler must provide the following functionality:

3.1.2.1 Scheduled Occupancy Input

Accept network variable of type _occupancy. Support the following
possible values: OC_STANDBY, OC_OCCUPIED and OC_UNOCCUPIED.

3.1.2.2 Occupancy Override Input

Accept network variable of type occupancy. Support the following possible
values: OC_STANDBY, OC_OCCUPIED, OC_UNOCCUPIED, and OC_NUL.

3.1.2.3 Space Occupancy Inputs

For systems with multiple occupancy sensors, accept multiple inputs of network variable type Occupancy. Support the following possible values: OC_OCCUPIED, OC_UNOCCUPIED, and OC_NUL. For systems with a single occupancy sensor, accept a network variable input of type SNVT_Occupancy or a hardware binary input (BI) indicating the space occupancy status as Occupied or Unoccupied.

3.1.2.4 Air Handler Occupancy Output

For a System Scheduler for a system containing an air handler, output one or more desired occupancy status as one of the following possible values: Warm-Up-Cool-Down (when required by the AHU Sequence of Operation), Occupied and Unoccupied.

3.1.2.5 Terminal Unit Occupancy Output

For a System Scheduler for a stand-alone terminal unit, or a group of terminal units served by a single air handler, output one or more signals from DDC indicating the desired occupancy status as one of the following possible values: Occupied and Unoccupied.

3.1.2.6 Default Schedule

Incorporate a 24-hour 7-day default schedule as shown on the drawings which may be activated and deactivated by the System Scheduler Logic.

3.1.2.7 Communication Determination

Determine the time elapsed between receipts of the scheduled occupancy input, and use this elapsed time to activate and deactivate the Default Schedule as specified. (This provides the capability for the system scheduler to use its Default Schedule if it loses communication with the UMCS).

3.1.3 System Scheduler Output Determination

For controlling an Air Handler, interpret a input of OC_STANDBY as Warm-Up-Cool-Down if the sequence of operation supports that mode, otherwise interpret OC_STANDBY as Occupied. For Terminal Units, interpret OC_STANDBY as Occupied.

3.1.3.1 Air Handler Occupancy Output

If more than 95 minutes have passed since the last receipt of the Scheduled Occupancy input, determine the Air Handler Occupancy Output by the default schedule and the Space Occupancy Inputs. Otherwise, determine the output as follows:

- a. If the Override Occupancy Input is not OC_NUL, determine the Air Handler Occupancy Output from the Override Occupancy Input.
- b. Otherwise, if at least the required number (as shown on the Occupancy Schedule Drawing) of Space Occupancy Inputs are OC_OCCUPIED or the hardware BI is Occupied the Air Handler Occupancy Output must be OC_OCCUPIED.

- c. Otherwise, determine the Air Handler Occupancy Output from the Scheduled Occupancy Input.

3.1.3.2 Terminal Unit Occupancy Output

If more than 95 minutes have passed since the last receipt of the Scheduled Occupancy input, determine the Terminal Unit Occupancy Output by the default schedule. Otherwise, determine the output as follows:

- a. If the Override Occupancy Input is not OC_NUL, determine the Terminal Unit Occupancy Output from the Override Occupancy Input:
- b. Otherwise, determine the Terminal Unit Occupancy Output from the Scheduled Occupancy.

3.1.4 Air Handler System Scheduling

- a. Bind the AHU Occupancy Output from the System Scheduler to the DDC Hardware that executes the Occupancy Mode Determination part of the Air Handler Sequence of Operation
- b. For Air Handlers using occupancy sensors, bind the output of each occupancy sensor to a Space Occupancy Input of the System Scheduler.
- c. Bind the Terminal Unit Occupancy Output from the System Scheduler to each AHU-Dependent Terminal Unit.
- d. AHU-Dependent Terminal Units with occupancy sensors must have the Effective Occupancy of each Terminal Unit bound to a Space Occupancy Input of the System Scheduler.

3.1.5 Stand-Alone Terminal Unit Scheduling

Bind the Terminal Unit Occupancy Output from the System Scheduler to the DDC Hardware that executes the Occupancy Mode Determination part of the Terminal Unit Sequence of Operation.

3.2 SEQUENCES OF OPERATION FOR MECHANICAL SYSTEMS

3.2.1 Rooftop Unit

See drawings for all sequences of operation.

3.2.2 Split System Heat Pump

See drawings for all sequences of operation.

3.2.3 Telecom Room DSS System

See drawings for all sequences of operation.

3.2.4 Exhaust Fan Controls - Roof Exhaust

See drawings for all sequences of operation.

3.2.5 Clean Agent Exhaust Fan Controls

See drawings for all sequences of operation.

3.2.6 Heating and Ventilating - Warehouse

See drawings for all sequences of operation.

3.2.7 Heating and Ventilating - Warehouse Restrooms

See drawings for all sequences of operation.

3.2.8 Unit Heaters / Cabinet Unit Heaters

See drawings for all sequences of operation.

3.2.9 Heating and Ventilation - Boat Building

See drawings for all sequences of operation.

3.2.10 Heating and Ventilation - Fire Pump Room

See drawings for all sequences of operation.

3.2.11 Hydronic Radiator Controls

See drawings for all sequences of operation.

3.3 SEQUENCES OF OPERATION FOR TERMINAL UNITS

3.3.1 Zone Temperature Control - VAV Box with Reheat

See drawings for all sequences of operation.

3.3.2 Zone Temperature Control - VAV Box no Heat

See drawings for all sequences of operation.

3.4 SEQUENCES OF OPERATION FOR HYDRONIC SYSTEMS

3.4.1 Heating Hot Water System

See drawings for all sequences of operation.

-- End of Section --

SECTION 23 11 20

FACILITY GAS PIPING
05/20

PART 1 GENERAL

1.1 SUMMARY

This specification section applies to gas piping installed within buildings, above ground steel piping and within buildings in compliance with NFPA 54/AGA Z223.1, "National Fuel Gas Code".

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN GAS ASSOCIATION (AGA)

AGA XR0603 (2006; 8th Ed) AGA Plastic Pipe Manual for Gas Service

AGA Z223.1 (2012) National Fuel Gas Code

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.24/CSA 6.10 (2015; R 2020) Connectors for Gas Appliances

ANSI Z21.41/CSA 6.9 (2014; R 2019) Quick-Disconnect Devices for Use with Gas Fuel Appliances

ANSI Z21.69/CSA 6.16 (2015; R 2020) Connectors for Movable Gas Appliances

ANSI Z21.93/CSA 6.30 (2017) Excess Flow Valves for Natural Gas and Propane Gas with Pressures up to 5 psig

AMERICAN PETROLEUM INSTITUTE (API)

API RP 1110 (2013; R 2018) Recommended Practice for the Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide

API RP 2009 (2002; R 2007; 7th Ed) Safe Welding, Cutting, and Hot Work Practices in Refineries, Gasoline Plants, and Petrochemical Plants

API Spec 6D (June 2018, 4th Ed; Errata 1 July 2018; Errata 2 August 2018) Specification for Pipeline and Piping Valves

API Std 598	(2009) Valve Inspecting and Testing
API Std 607	(2016) Fire Test for Quarter-turn Valves and Valves Equipped with Non-metallic Seats

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1	(2020) Scheme for the Identification of Piping Systems
ASME B1.1	(2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2016) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.33	(2012; R 2017) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psi, (Sizes NPS 1/2 - NPS 2)
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B31.8	(2018; Supplement 2018) Gas Transmission and Distribution Piping Systems
ASME B31.9	(2017) Building Services Piping
ASME B36.10M	(2015; Errata 2016) Welded and Seamless Wrought Steel Pipe
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing

Qualifications

ASME BPVC SEC VIII D1 (2019) BPVC Section VIII-Rules for
Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM 01.01 (2019) Steel - Piping, Tubing, Fittings

ASTM A53/A53M (2020) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

ASTM A105/A105M (2018) Standard Specification for Carbon
Steel Forgings for Piping Applications

ASTM A193/A193M (2020) Standard Specification for
Alloy-Steel and Stainless Steel Bolting
Materials for High-Temperature Service and
Other Special Purpose Applications

ASTM A194/A194M (2020a) Standard Specification for Carbon
Steel, Alloy Steel, and Stainless Steel
Nuts for Bolts for High-Pressure or
High-Temperature Service, or Both

ASTM A513/A513M (2020a) Standard Specification for
Electric-Resistance-Welded Carbon and
Alloy Steel Mechanical Tubing

CSA GROUP (CSA)

ANSI LC 1/CSA 6.26 (2019) Fuel Gas Piping Systems Using
Corrugated Stainless Steel Tubing (CSST)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-25 (2018) Standard Marking System for Valves,
Fittings, Flanges and Unions

MSS SP-58 (2018) Pipe Hangers and Supports -
Materials, Design and Manufacture,
Selection, Application, and Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (2021) National Fuel Gas Code

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101 (2014; Rev C) Color Code for Pipelines and
for Compressed Gas Cylinders

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

49 CFR 192

Transportation of Natural and Other Gas by
Pipeline: Minimum Federal Safety Standards

UNDERWRITERS LABORATORIES (UL)

UL FLAMMABLE & COMBUSTIBLE

(2012) Flammable and Combustible Liquids
and Gases Equipment Directory

1.3 SYSTEM DESCRIPTION

The gas piping system includes natural gas piping and appurtenances from point of connection with supply system, as indicated, to gas operated equipment within the facility. Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, in three separate packages. Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to this section, with additions and modifications specified herein.

1.3.1 Gas Facility System and Equipment Operation

Include shop drawings showing piping layout, locations of system valves, gas line markers; step-by-step procedures for system start up, operation and shutdown (index system components and equipment to the system drawings); isolation procedures including valve operation to shutdown or isolate each section of the system (index valves to the system maps and provide separate procedures for normal operation and emergency shutdown if required to be different). Submit Data package No. 4.

1.3.2 Gas Facility System Maintenance

Include maintenance procedures and frequency for system and equipment; identification of pipe materials and manufacturer by locations, pipe repair procedures, and jointing procedures at transitions to other piping material or material from a different manufacturer. Submit Data Package No.4.

1.3.3 Gas Facility Equipment Maintenance

Include identification of valves, shut-offs, disconnects, and other equipment by materials, manufacturer, vendor identification and location; maintenance procedures and recommended tool kits for valves and equipment; recommended repair methods (i.e., field repair, factory repair, or replacement) for each valve and piece of equipment; and preventive maintenance procedures, possible failure modes and troubleshooting guide. Submit Data Package No. 3.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Gas Piping System; G

SD-03 Product Data

Gas Equipment Connectors; G

Gas Piping System and Pipe Fittings; G

Valves; G

Warning and Identification Tape; G

Pipe coating materials; G

SD-06 Test Reports

Testing; G

Pressure Tests; G

Test with Gas; G

SD-07 Certificates

Welders Procedures and Qualifications; G

Assigned Number, Letter, or Symbol; G

SD-10 Operation and Maintenance Data

Gas Facility System and Equipment Operation; G

Gas Facility System Maintenance; G

Gas Facility Equipment Maintenance; G

1.5 QUALITY ASSURANCE

Submit manufacturer's descriptive data and installation instructions for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Mark all valves, flanges and fittings in accordance with MSS SP-25.

1.5.1 Welding Qualifications

- a. Weld piping in accordance with qualified procedures using performance qualified welders and welding operators in accordance with API RP 2009, ASME BPVC SEC IX, and ASME B31.9. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.9. Notify the Contracting Officer at least 24 hours in advance of tests, and perform at the work site if practicable.
- b. Submit a certified copy of welders procedures and qualifications metal and PE in conformance with ASME B31.9 for each welder and welding operator. Submit the assigned number, letter, or symbol that will be used in identifying the work of each welder to the Contracting Officer.

1.5.2 Shop Drawings

Submit drawings for complete Gas Piping System, within 30 days of contract

award, showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of gas equipment connectors and supports.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos are not allowed. Submit catalog data and installation instructions for pipe, valves, all related system components, pipe coating materials and application procedures. Conform to NFPA 54 and with requirements specified herein. Provide supply piping to appliances or equipment at least as large as the inlets thereof.

2.2 GAS PIPING SYSTEM AND PIPE FITTINGS

2.2.1 Steel Pipe, Joints, and Fittings

- a. Pipe: Black carbon steel in accordance with ASTM A53/A53M, Schedule 40, threaded ends for sizes 2 inches and smaller; otherwise, plain end beveled for butt welding.
- b. Threaded Fittings: ASME B16.3, black malleable iron.
- c. Socket-Welding Fittings: ASME B16.11, forged steel.
- d. Butt-Welding Fittings: ASME B16.9, with backing rings of compatible material.
- e. Unions: ASME B16.39, black malleable iron.
- f. Flanges and Flanged Fittings: ASME B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVC SEC VIII D1, with flange faces having integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.

Provide steel pipe conforming to ASME B36.10M; and malleable-iron threaded fittings conforming to ASME B16.1 and ASME B16.3. Provide steel pipe flanges and flanged fittings, including bolts, nuts, and bolt pattern in accordance with ASME B16.5 and ASTM A105/A105M. Provide wrought steel butt welding fittings conforming to ASME B16.9. Provide socket welding and threaded forged steel fittings conforming to ASME B16.11.

2.2.2 Steel Tubing, Joints and Fittings

Provide steel tubing conforming to ASTM 01.01, and ASTM A513/A513M, with tubing joints made up with gas tubing fittings recommended by the tubing manufacturer.

2.2.3 Corrugated Stainless Steel Tubing, Fittings and Accessories

2.2.3.1 Striker Plates

Hardened steel designed to protect tubing from mechanical damage in accordance with ANSI LC 1/CSA 6.26

2.2.4 Sealants for Steel Pipe Threaded Joints

Provide joint sealing compound as listed in UL FLAMMABLE & COMBUSTIBLE, Class 20 or less. For taping, use tetrafluoroethylene tape conforming to UL FLAMMABLE & COMBUSTIBLE.

2.2.5 Warning and Identification

Provide pipe flow markings, warning and identification tape, and metal tags as required.

2.2.6 Flange Gaskets

Provide gaskets of nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type, containing aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 600 degree F service, to be used for hydrocarbon service.

2.2.7 Pipe Threads

Provide pipe threads conforming to ASME B1.20.1.

2.2.8 Escutcheons

Provide chromium-plated steel or chromium-plated brass escutcheons, either one piece or split pattern, held in place by internal spring tension or set screw.

2.2.9 Insulating Pipe Joints

2.2.9.1 Insulating Joint Material

Provide insulating joint material between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.2.9.2 Threaded Pipe Joints

Provide threaded pipe joints of steel body nut type dielectric unions with insulating gaskets.

2.2.9.3 Flanged Pipe Joints

Provide joints for flanged pipe consisting of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts.

2.2.10 Flexible Connectors

- a. Provide flexible connectors for connecting gas utilization equipment to building gas piping conforming to ANSI Z21.24/CSA 6.10 or ANSI Z21.41/CSA 6.9 for quick disconnect devices, and flexible connectors for movable food service equipment conforming to ANSI Z21.69/CSA 6.16.
- b. Do not install the flexible connector through the appliance cabinet face. Provide rigid metallic pipe and fittings to extend the final connection beyond the cabinet, except when appliance is provided with

an external connection point.

2.3 VALVES

Provide lockable shutoff or service isolation valves conforming to the following:

2.3.1 Valves 2 Inches and Smaller

Provide valves 2 inches and smaller conforming to ASME B16.33 of materials and manufacture compatible with system materials used.

2.3.2 Valves 2-1/2 Inches and Larger

Provide valves 2-1/2 inches and larger of carbon steel conforming to API Spec 6D, Class 150.

2.4 PIPE HANGERS AND SUPPORTS

Provide pipe hangers and supports conforming to MSS SP-58.

2.5 NATURAL GAS SERVICE

2.5.1 Gas Meter

2.5.1.1 Utility Monitoring and Control System (UMCS) / Energy Monitoring and Control (EMCS) or Automatic Meter Reading Interfaces

Provide gas meters capable of interfacing the output signal, equivalent to volumetric flow rate, with the existing UMCS / EMCS for data gathering in units of cubic meters cubic feet. Provide meters that do not require power to function and deliver data. Output signal must be either a voltage or amperage signal that can be converted to volumetric flow by using an appropriate scaling factor.

2.5.1.2 Measurement Configuration

For buildings that already have a gas meter with a pulse output, ensure that the pulse output is connected to a data gathering device (i.e. electric meter). For buildings where a natural gas meter already exists but does not have a pulse output, add a pulse kit to the existing meter and tie the output to a data gathering device. If the existing gas meter will not accept a pulse kit or if no meter exists a new natural gas meter must be installed, also requiring a pulse output to a data gathering device. Ensure the pulse frequency and electronic characteristics are compatible with the existing data gathering device, if any.

2.6 AUTOMATIC GAS SHUT-OFF

Provide low pressure automatic gas shutoff downstream of the point of delivery after the meter/regulator conforming to ANSI Z21.93/CSA 6.30 and UL listed or CSA listed or International Association of Plumbing and Mechanical Officials (IAPMO) listed.

2.7 BOLTING (BOLTS AND NUTS)

Stainless steel bolting; ASTM A193/A193M, Grade B8M or B8MA, Type 316, for bolts; and ASTM A194/A194M, Grade 8M, Type 316, for nuts. Dimensions of bolts, studs, and nuts must conform with ASME B18.2.1 and ASME B18.2.2

with coarse threads conforming to ASME B1.1, with Class 2A fit for bolts and studs and Class 2B fit for nuts. Bolts or bolt-studs must extend through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Bolts must have American Standard regular square or heavy hexagon heads; nuts must be American Standard heavy semifinished hexagonal.

2.8 GASKETS

Fluorinated elastomer, compatible with flange faces.

2.9 IDENTIFICATION FOR ABOVEGROUND PIPING

MIL-STD-101 for legends and type and size of characters. For pipes 3/4 inch od and larger, provide printed legends to identify contents of pipes and arrows to show direction of flow. Color code label backgrounds to signify levels of hazard. Make labels of plastic sheet with pressure-sensitive adhesive suitable for the intended application. For pipes smaller than 3/4 inch od, provide brass identification tags 1 1/2 inches in diameter with legends in depressed black-filled characters.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy or areas of conflict before performing the work.

3.2 EXCAVATION AND BACKFILLING

Provide required excavation, backfilling, and compaction as specified in Section 31 23 00.00 EXCAVATION AND FILL.

3.3 GAS PIPING SYSTEM

Provide a gas piping system from the point of delivery, defined as the outlet of the meter set assembly, to the connections to each gas utilization device that is in compliance with NFPA 54.

3.3.1 Protection and Cleaning of Materials and Components

Protect equipment, pipe, and tube openings by closing with caps or plugs during installation. At the completion of all work, thoroughly clean the entire system.

3.3.2 Workmanship and Defects

Piping, tubing and fittings must be clear and free of cutting burrs and defects in structure or threading and must be thoroughly brushed and chip-and scale-blown. Repair of defects in piping, tubing or fittings is not allowed; replace defective items when found.

3.4 INSTALLATION

Install the gas system in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54 and AGA XR0603, and as indicated. Perform all pipe cutting without damage to the pipe, with an approved type of mechanical cutter, unless otherwise authorized. Use

wheel cutters where practicable. On steel pipe 6 inches and larger, an approved gas cutting and beveling machine may be used. Cut thermoplastic and fiberglass pipe in accordance with AGA XR0603.

3.4.1 Metallic Piping Installation

Make changes in direction of piping with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction is not permitted. Branch connection may be made with either tees or forged branch outlet fittings. Provide branch outlet fittings which are forged, flared for improvement of flow where attached to the run, and reinforced against external strains.

3.4.2 Aboveground Piping

Run aboveground piping as straight as practicable along the alignment and elevation indicated, with a minimum of joints, and separately supported from other piping system and equipment. Install exposed horizontal piping no farther than 6 inches from nearest parallel wall and at an elevation which prevents standing, sitting, or placement of objects on the piping.

3.4.3 Final Gas Connections

Unless otherwise specified, make final connections with rigid metallic pipe and fittings. Flexible connectors may be used for final connections to gas utilization equipment. In addition to cautions listed in instructions required by ANSI standards for flexible connectors, insure that flexible connectors do not pass through equipment cabinet. Provide accessible gas shutoff valve and coupling for each gas equipment item.

3.5 PIPE JOINTS

Design and install pipe joints to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.5.1 Threaded Metallic Joints

Provide threaded joints in metallic pipe with tapered threads evenly cut and made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 1-1/2 inches in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 2 inches in diameter may be made with approved joint sealing compound. After cutting and before threading, ream pipe and remove all burrs. Caulking of threaded joints to stop or prevent leaks is not permitted.

3.5.2 Welded Metallic Joints

Conform beveling, alignment, heat treatment, and inspection of welds to NFPA 54. Remove weld defects and make repairs to the weld, or remove the weld joints entirely and reweld. After filler metal has been removed from its original package, protect and store so that its characteristics or welding properties are not affected adversely. Do not use electrodes that have been wetted or have lost any of their coating.

3.6 PIPE SLEEVES

Provide pipes passing through concrete or masonry walls or concrete floors or roofs with pipe sleeves fitted into place at the time of construction.

Do not install sleeves in structural members except where indicated or approved. Make all rectangular and square openings as detailed. Extend each sleeve through its respective wall, floor or roof, and cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Extend sleeves in mechanical room floors above grade at least 4 inches above finish floor. Unless otherwise indicated, use sleeves large enough to provide a minimum clearance of 1/4 inch all around the pipe. Provide steel pipe for sleeves in bearing walls, waterproofing membrane floors, and wet areas. Provide sleeves in nonbearing walls, floors, or ceilings of steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. For penetrations of fire walls, fire partitions and floors which are not on grade, seal the annular space between the pipe and sleeve with fire-stopping material and sealant that meet the requirement of Section 07 84 00 FIRESTOPPING.

3.7 PIPES PENETRATING WATERPROOFING MEMBRANES

Install pipes penetrating waterproofing membranes as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.8 FIRE SEAL

Fire seal all penetrations of fire rated partitions, walls and floors in accordance with Section 07 84 00 FIRESTOPPING.

3.9 ESCUTCHEONS

Provide escutcheons for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.10 SPECIAL REQUIREMENTS

Provide drips, grading of the lines, freeze protection, and branch outlet locations as shown and conforming to the requirements of NFPA 54.

3.11 BUILDING STRUCTURE

Do not weaken any building structure by the installation of any gas piping. Do not cut or notch beams, joists or columns. Attach piping supports to metal decking. Do not attach supports to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer.

3.12 PIPING SYSTEM SUPPORTS

Support gas piping systems in buildings with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Do not support any gas piping system by other piping. Conform spacing of supports in gas piping and tubing installations to the requirements of NFPA 54. Conform the selection and application of supports in gas piping and tubing installations to the requirements of MSS SP-58. In the support of multiple pipe runs on a common base member, use a clip or clamp where each pipe crosses the base support member. Spacing of the base support members is not to exceed the hanger and support spacing required for any of the individual pipes in the multiple pipe run. Rigidly connect the clips or clamps to the common base member. Provide a clearance of 1/8 inch between the pipe and clip or clamp for all piping which may be subjected

to thermal expansion.

3.13 ELECTRICAL BONDING AND GROUNDING

Provide a gas piping system within the building that is electrically continuous and bonded to a grounding electrode as required by NFPA 54, and NFPA 70.

3.14 SHUTOFF VALVE

Install the main gas shutoff valve controlling the gas piping system to be easily accessible for operation, as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled. Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally. Provide stop valve on service branch at connection to main and shut-off valve on riser outside of building.

3.15 LINE AND APPLIANCE PRESSURE REGULATORS

Install line pressure regulators and appliance regulators in accordance with the manufacturer's requirements and in accordance with NFPA 54. Install each regulator in an accessible location and install shutoff valves ahead of each line and appliance regulator to allow for maintenance. Where vent limiting devices are not included in the regulators, install a vent pipe to the exterior of the building. Terminate all service regulator vents and relief vents in the outside air in rain and insect resistant fittings. Locate the open end of the vent where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

3.16 GAS SERVICE INSTALLATION

Installations must be in accordance with 49 CFR 192 and ASME B31.8. Contractor must submit and use only tested and approved work procedures. Contractor must use only welders and jointers who have been recently qualified by training and test for joining and installing the gas pipe material used on this job. The finished product must be inspected by a person qualified to inspect joints made by the particular procedures used to make joints.

3.16.1 Service Regulator

Install service regulator in accordance with 49 CFR 192 and ASME B31.8 and this specification ensuring that the customer's piping is protected from over pressurization should the service regulator fail. A 3/8 inch tapped fitting equipped with a plug must be provided on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. For inside installations, route the regulator vent pipe through the exterior wall to the atmosphere, and seal building penetrations for service line and vent. Terminate the regulator vent so that it is protected from precipitation and insect intrusion, so that it is not submerged during floods, and so that gas escaping will not create a hazard or enter the building through openings.

3.16.2 Gas Meter

Install shutoff valve, meter set assembly, and service regulator on the service line outside the building, 18 inches above the ground on the

riser. An insulating joint (dielectric connection) must be installed on the inlet side of the meter set assembly and service regulator and must be constructed to prevent flow of electrical current.

3.17 TESTING

Submit test procedures and reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Test entire gas piping system to ensure that it is gastight prior to putting into service. Prior to testing, purge the system, clean, and clear all foreign material. Test each joint with an approved gas detector, soap and water, or an equivalent nonflammable solution. Inspect and test each valve in conformance with API Std 598 and API Std 607. Complete testing before any work is covered, enclosed, or concealed, and perform with due regard for the safety of employees and the public during the test. Install bulkheads, anchorage and bracing suitably designed to resist test pressures if necessary, and as directed and or approved by the Contracting Officer. Do not use oxygen as a testing medium.

3.17.1 Pressure Tests

Submit test procedures and reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Before appliances are connected, test by filling the piping systems with air or an inert gas to withstand a minimum pressure of 3 pounds gauge for a period of not less than 10 minutes as specified in NFPA 54 without showing any drop in pressure. Do not use Oxygen for test. Measure pressure with a mercury manometer, slope gauge, or an equivalent device calibrated to be read in increments of not greater than 0.1 pound. Isolate the source of pressure before the pressure tests are made.

3.17.2 Test With Gas

Before turning on gas under pressure into any piping, close all openings from which gas can escape. Immediately after turning on the gas, check the piping system for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. Conform all testing to the requirements of NFPA 54. If leakage is recorded, shut off the gas supply, repair the leak, and repeat the tests until all leaks have been stopped.

3.17.3 Purging

After testing is completed, and before connecting any appliances, fully purge all gas piping. LPG piping tested using fuel gas with appliances connected does not require purging. Conform testing procedures to API RP 1110. Do not purge piping into the combustion chamber of an appliance. Do not purge the open end of piping systems into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.

3.17.4 Labor, Materials and Equipment

Furnish all labor, materials and equipment necessary for conducting the testing and purging.

3.18 PIPE COLOR CODE MARKING

Provide color code marking of piping as specified in Section 09 90 00
PAINTS AND COATINGS, conforming to ASME A13.1.

-- End of Section --

SECTION 23 21 13.00 20

LOW TEMPERATURE WATER (LTW) HEATING SYSTEM

04/06, CHG 2: 11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2016) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B31.9	(2017) Building Services Piping
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

- ASSE 1003 (2009) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
- ASSE 1017 (2009) Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems - (ANSI approved 2010)

AMERICAN WELDING SOCIETY (AWS)

- AWS Z49.1 (2012) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

- ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- ASTM A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A194/A194M (2020a) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
- ASTM A307 (2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
- ASTM B32 (2020) Standard Specification for Solder Metal
- ASTM B88 (2020) Standard Specification for Seamless Copper Water Tube

COPPER DEVELOPMENT ASSOCIATION (CDA)

- CDA A4015 (2016; 14/17) Copper Tube Handbook

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

- MSS SP-58 (2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
- MSS SP-67 (2017; Errata 1 2017) Butterfly Valves
- MSS SP-72 (2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service
- MSS SP-80 (2019) Bronze Gate, Globe, Angle and Check

Valves

MSS SP-110 (2010) Ball Valves Threaded,
Socket-Welding, Solder Joint, Grooved and
Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA 1780 (2002) HVAC Systems - Testing, Adjusting
and Balancing, 3rd Edition

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1689 (Rev B) Tape, Pressure-Sensitive Adhesive,
(Plastic Film)

CID A-A-50560 (Basic) Pumps, Centrifugal, Water
Circulating, Electric-Motor-Driven

CID A-A-59617 (Basic, Notice 1) Unions, Brass or Bronze,
Threaded Pipe Connections and Solder-Joint
Tube Connections

FS WW-S-2739 (Basic; Notice 1; Notice 2) Strainers,
Sediment: Pipeline, Water, Air, Gas, Oil,
or Steam

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.144 Safety Color Code for Marking Physical
Hazards

29 CFR 1910.219 Mechanical Power Transmission Apparatus

1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to
this section with additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Except as specified otherwise, equipment and piping components shall be
suitable for use in low temperature water heating system. Except as
modified herein, the pressure temperature limitations shall be as
specified in the referenced standards and specifications. Pressures in
this specification are pressures in pounds per square inch above
atmospheric pressure, and temperatures are in degrees Fahrenheit (F).

1.3.1 Hot Water Heating System

Submit plan, elevations, dimensions, capacities, and ratings. Include the
following:

a. Unit heaters

- b. Pumps
- c. Valves
- d. Expansion tanks
- e. Flow measuring equipment
- f. Air separating tank

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Hot water heating system;G

SD-03 Product Data

Pumps;G

Include pump speed and characteristic curve for performance of impeller selected for each pump. Curves shall indicate capacity vs head, efficiency, and brake power for full range, from shut-off to free delivery.

Expansion tanks

Flow control balancing valves

External air separation tanks

Hot water heating pipe;G

SD-06 Test Reports

Hydrostatic test of piping system

Auxiliary equipment and accessory tests

Submit test reports in accordance with the paragraph entitled "Field Quality Control."

SD-07 Certificates

Report of prior installations

Welding procedures

Welder's qualifications

1.5 QUALITY ASSURANCE

1.5.1 Standard Commercial Product for Terminal Units

Terminal units provided shall comply with features called out in this specification and shall be the manufacturer's standard commercial product. Additional or better features which are not prohibited by this specification but which are a part of the manufacturer's standard commercial product, shall be included in the terminal units being furnished. A standard commercial product is a product which has been sold or is currently being offered for sale, on the commercial market through advertisements or manufacturer's catalogs, or brochures. Provide Institute of Boiler and Radiator Manufacturer (IBR) or Steel Boiler Institute (SBI) rating for required capacity.

1.5.2 Welding

1.5.2.1 Report of Prior Installations

Submit a Certificate of Full Approval or a current Certificate of Approval for each design, size, and make of backflow preventer being provided for the project. Certificate shall be from the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California, and shall attest that this design, size, and make of backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. A Certificate of Provisional Approval is not acceptable in lieu of the above.

1.5.2.2 Welding Procedures

Before performing welding, submit three copies of welding procedure specification for all metals to be used in the work, together with proof of welder's qualification as outlines in ASME B31.9.

1.5.2.3 Welder's Qualifications

Before welder or operator performs welding, submit three copies of Welder's Performance Qualification Record in conformance with ASME B31.9 showing that the welder was tested under the approved procedure specification submitted by the Contractor. In addition, submit each welder's assigned number, letter, or symbol used to identify the work of the welder.

1.5.2.4 Identification of Welder's Work

Ensure that each welder's assigned number, letter or symbol is affixed immediately upon completion of the weld. To welders making defective welds after passing a qualification test, give a requalification test. Upon failing to pass the test, do not permit welder to work in this contract.

1.5.2.5 Previous Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without requalification subject to the approval and provided that all the conditions specified in ASME B31.9 are met before a procedure can be used.

1.5.3 Brazing and Soldering

1.5.3.1 Brazing Procedure

ASME B31.9. Brazing procedure for joints shall be as outlined in CDA A4015.

1.5.3.2 Soldering, Soldering Preparation, and Procedures for Joints

ASME B31.9 and as outlined in CDA A4015.

1.6 SAFETY STANDARDS

1.6.1 Welding

Safety in welding and cutting of pipe shall conform to AWS Z49.1.

1.6.2 Guards

Couplings, motor shafts, gears and other moving parts shall be guarded, in accordance with OSHA 29 CFR 1910.219. Guards shall be cast iron or expanded metal. Guard parts shall be rigid and removable without disassembling the guarded unit.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Hot Water Heating Pipe (Supply and Return)

ASTM A53/A53M electric resistance welded or seamless Schedule 40 steel pipe or ASTM B88 Type L hard drawn Copper tubing.

2.1.2 Fittings

Provide fittings compatible with the pipe being provided and shall conform to the following requirements.

2.1.2.1 Steel or Malleable Iron Pipe

Sizes 1/8 to 2 inches. ASME B16.11 steel socket welding or screwed type or ASME B16.3 for screwed type malleable iron fittings.

2.1.2.2 Steel

Sizes 2 1/2 inches and above. Steel fitting butt welding type ASME B16.9 or ASME B16.5 flanged type.

2.1.2.3 Fittings for Copper Tubing

ASME B16.18 cast bronze solder joint type or ASME B16.22 wrought copper solder joint type. Fittings may be flared or compression joint type.

2.1.3 Unions

2.1.3.1 Steel Pipe

Provide ASME B16.39, malleable iron unions, threaded connections.

2.1.3.2 Copper Tubing

Provide CID A-A-59617, bronze unions, solder joint end.

2.1.3.3 Dielectric Union

Provide insulated union with galvanized steel female pipe-threaded end and a copper solder joint end conforming with ASME B16.39, Class 1, dimensional, strength and pressure requirements. Union shall have a water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600-volt breakdown test.

2.1.4 Flanges

Remove raised faces when used with flanges having a flat face.

2.1.4.1 Steel Flanges

ASME B16.5 forged steel, welding type.

2.1.5 Drains and Overflows

2.1.5.1 Steel Pipe

ASTM A53/A53M, Seamless Schedule 40, Malleable iron or forged steel fittings, screwed or welded joints.

2.1.5.2 Copper Tubing

ASTM B88, Type L, hard drawn, cast brass or wrought copper fittings, Grade Sb5 solder joints.

2.1.6 Valves

Valves shall have rising stems and shall open when turned counterclockwise.

2.1.6.1 Check Valves

- a. Bronze Check Valves: MSS SP-80, 2 inches and smaller, regrinding swing check type, Class 200.

2.1.6.2 Temperature Regulating Valves

Provide ASSE 1017 copper alloy body with adjustable range thermostat.

2.1.6.3 Water Pressure-Reducing Valves

ASSE 1003.

2.1.6.4 Ball Valves

Flanged or butt-welding ends ball valve shall conform to MSS SP-72, bronze or steel. Threaded, socket-welding, or solder joint shall conform to MSS SP-110.

2.1.6.5 Radiator Valves

Radiator valves shall be angle or straightway pattern, with packed or packless bonnet shutoff globe type, designed especially for hot water heating system. Valve shall be constructed of brass or bronze or copper alloy conforming to ASTM specifications for materials with non-metallic renewable disc and plastic wheel handle for shutoff service.

2.1.6.6 Flow Control Balancing Valves

Brass, bronze, or copper body with threaded or sweat connections. Factory set to maintain constant flow rate with +/- 10% accuracy over system pressure fluctuations; operating ranges shall fall within 2-60 psid. Each valve shall have an identification label, or tag attached by chain, and be factory marked with manufacturer identification, valve series, and flow rate. Valves shall be suitable for 125 psig at 190 degrees F hot water. Flow control cartridge shall consist of a brass, stainless steel, or elastomeric diaphragm and polyphenylsulfone orifice plate. Flow control cartridge shall be able to be removed and replaced. Combination valve assemblies shall be Y-type body, flow-control cartridge, ball valve, pressure/temperature ports, and union-end connection.

2.1.6.7 Butterfly Valves

Conform with MSS SP-67, Type I - Tight shut off valve, and flanged valve ends. Valve body material shall be steel and shall be bubble tight for shutoff at 150 psig. Flanged and flangeless type valves shall have Type 300 series corrosion resistant steel stems and corrosion resistant or bronze discs with molded elastomer disc seals. Flow conditions shall be for the regulation from maximum flow to complete shutoff by way of throttling effect. Valves shall be provided in closed system. Valves smaller than 8 inches shall have throttling handles. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and indicators. Valves shall have a minimum of 7 locking positions and shall be suitable for water temperatures up to 200 degrees F.

2.1.6.8 Butterfly Valves 2 Inches and Smaller

Valves shall be one-piece and three-piece design with male or female threaded or soldered end connections and shall be bubble tight for shutoff at 150 psig. Stem and disc assembly shall be of 300 series corrosion resistant steel. Disc seal assembly shall be of 300 series corrosion resistant steel. Disc seal shall be suitable for the liquid being used in the system in which the valve is to be installed. Valves shall be suitable for water temperature up to 200 degrees F and shall be capable of operating at the rated pressure of 150 psig. Valves shall be designed for throttling service use by valve lever and indicator adjustment.

2.1.6.9 Relief Valves

Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.1.6.10 Balancing Valves

Balancing valves shall be calibrated bronze body balancing valves with integral ball valve and venturi or valve orifice and valve body pressure taps for flow measurement based on differential pressure readings. Valve

pressure taps and meter connections shall have seals and built-in check valves with threaded connections for a portable meter. Meter shall be provided by the same manufacturer and be capable of reading system pressures and shall meet the requirements of the paragraph entitled "Flow Measuring Equipment." Valves shall have internal seals to prevent leakage around rotating element and be suitable for full shut-off rated pressure. Valves shall have an operator with integral pointer and memory stop. Balancing valves shall be selected for the required flows as indicated on the plans.

2.1.7 End Connections

2.1.7.1 Flexible Connectors

Provide flexible pipe connectors on piping connected to equipment. Flexible section shall consist of rubber, tetrafluoroethylene resin, corrosion-resistant steel, bronze, monel, or galvanized steel. Material provided and configuration shall be suitable for pressure, temperature, and circulating medium. Flexible section shall have threaded, soldering, or socket-weld ends and shall be suitable for service intended. Flexible section may be reinforced with metal retaining rings, with built-in braided wire reinforcement and restriction bolts or with wire braid cover suitable for service intended.

2.1.7.2 Steel Piping

Screwed or socket welded for 2 inches and smaller and flanged or butt welded for 2 1/2 inches and larger.

a. Screwed Joints With Taper Threads: ASME B1.20.1.

b. Flanged Joints: Bolting and gaskets shall be as follows:

(1) Bolting: Bolt and stud material ASTM A307, Grade B, and nut material ASTM A194/A194M, Grade 2. Bolt, stud, and nut dimensions ASME B18.2.2 threads ASME B1.1 coarse type with Class 2A fit for bolts and studs, and Class 2B fit for nuts. Bolts or bolt studs shall extend completely through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Carbon steel bolts shall have American Standard regular square or heavy hexagon heads and shall have American Standard heavy semifinished hexagonal nuts conforming to ASME B18.2.2.

(2) Gaskets: ASME B16.21, Nonasbestos compressed material 1/16 inch thickness full face or self-centering flat ring type and suitable for pressure and temperature of the piping system.

c. Butt Weld Joints: ASME B31.9. Backing rings shall conform to ASME B31.9. Ferrous rings shall not exceed 0.05 percent sulfur; for alloy pipe, backing rings shall be of material compatible with the chemical composition of the parts to be welded and preferably of the same composition. Provide continuous machined or split band backing rings.

d. Socket Weld Joints: ASME B31.9.

2.1.7.3 Joints for Copper Tubing

a. Solder conforming to ASTM B32 alloy grade Sb5 or Sn96. Solder and

flux shall be lead free (less than 0.2 percent of lead).

2.1.8 Instrumentation

2.1.8.1 Pressure and Vacuum Gauges

Provide ASME B40.100 with restrictor.

2.1.8.2 Indicating Thermometers

Thermometers shall be dial type with an adjustable angle suitable for the service. Provide thermowell sized for each thermometer in accordance with the thermowell specification. Fluid-filled thermometers (mercury is not acceptable) shall have a nominal scale diameter of 5 inches. Construction shall be stainless-steel case with molded glass cover, stainless-steel stem and bulb. Stem shall be straight, length as required to fit well. Bimetal thermometers shall have a scale diameter of 3 1/2 inches. Case shall be hermetic. Case and stem shall be constructed of stainless steel. Bimetal stem shall be straight and of a length as required to fit the well.

2.1.8.3 Pressure/Temperature Test Ports

Pressure/Temperature Test Ports shall have brass body and EPDM and/or Neoprene valve seals. Ports shall be rated for service between 35 and 275 degrees F and up to 500 psig. Ports shall be provided in lengths appropriate for the insulation thickness specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and installed to allow a minimum of 12 inches of access for probe insertion. Provide with screw-on cap attached with a strap or chain to prevent loss when removed. Ports shall be 1/4 inch NPT and accept 1/8 inch diameter probes.

2.1.9 Miscellaneous Pipeline Components

2.1.9.1 Air Vent

Provide float type air vent in hydronic systems. Vent shall be constructed of brass or semi-steel body, copper float, and stainless steel valve and valve seat. Design air vent to suit system operating temperature and pressure. Provide isolating valve to permit service without draining the system. Pipe discharge of vent to a drain.

2.1.9.2 Strainers

Strainers for classes 125 and 250 piping in IPS 1/2 to 8 inches, inclusive, FS WW-S-2739 and locate as indicated.

2.1.9.3 Hangers and Supports

Design and fabrication of pipe hangers, supports, and welding attachments shall conform to MSS SP-58 and ASME B31.9. All hangers, supports and fasteners shall be 304L stainless steel.

2.1.9.4 Pipe Sleeves

Sleeves in masonry and concrete walls, floors, and roof slabs shall be ASTM A53/A53M, Schedule 40 or Standard Weight, hot-dip galvanized steel pipe. Sleeves in partitions shall be zinc-coated sheet steel having a nominal weight of not less than 0.906 pound per square foot.

2.1.9.5 Escutcheon Plates

Provide one piece or split hinge metal plates for piping passing through floors, walls, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces and paint finish on metal plates in unfinished spaces.

2.2 CENTRAL MECHANICAL EQUIPMENT

2.2.1 Boilers

Provide as specified in Section 23 52 43.00 20 LOW PRESSURE WATER HEATING BOILERS UNDER 800,000 BTU/HR OUTPUT.

2.3 PIPING SYSTEM EQUIPMENT

2.3.1 Pumps

Pumps shall be the electrically driven, non-overloading, centrifugal type which conform to HI 1.1-1.2. Pumps shall be selected at or within 5 percent of peak efficiency. Pump curve shall rise continuously from maximum capacity to shutoff. Pump motor shall conform to NEMA MG 1, be splash-proof, and have sufficient horsepower for the service required. Pump motor shall have the required capacity to prevent overloading with pump operating at any point on its characteristic curve. Pump speed shall not exceed 3,600 rpm, except where the pump head is less than 60 feet of water, the pump speed shall not exceed 1,750 rpm. Provide variable frequency drives for motors as specified in Section 26 29 23 VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS. Provide inverter-ready motors meeting NEMA MG 1 Part 31 for motors with variable frequency drives. Provide split-shaft grounding rings for all motors with variable frequency drives.

2.3.1.1 Construction

Each pump casing shall be designed to withstand the discharge head specified plus the static head on system plus 50 percent of the total, but not less than 125 psig. Pump casing and bearing housing shall be close grained cast iron. High points in the casing shall be provided with manual air vents; low points shall be provided with drain plugs. Provide threaded suction and discharge pressure gage tapping with square-head plugs.

Impeller shall be statically and dynamically balanced. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve shall be bronze. Shaft shall be carbon or alloy steel, turned and ground. Bearings shall be ball-bearings, roller-bearings, or oil-lubricated bronze-sleeve type bearings, and be efficiently sealed or isolated to prevent loss of oil or entrance of dirt or water.

Pump and motor shall be mounted on a common cast iron base having lipped edges and tapped drainage openings or structural steel base with lipped edges or drain pan and tapped drainage openings. Pump shall be provided with steel shaft coupling guard. Base-mounted pump, coupling guard, and motor shall each be bolted to a fabricated steel base which shall have bolt holes for securing base to supporting surface. Pump shall be accessible for servicing without disturbing piping connections. Shaft seals shall be mechanical-seals.

2.3.1.2 Mechanical Shaft Seals

Seals shall be single, inside mounted, end-face-elastomer bellows type with stainless steel spring, brass or stainless steel seal head, carbon rotating face, and tungsten carbide or ceramic sealing face. Glands shall be bronze and of the water-flush design to provide lubrication flush across the face of the seal. Bypass line from pump discharge to flush connection in gland shall be provided, with filter or cyclone particle separator in line.

2.3.2 Circulating Pumps

Provide hot water circulating pumps, CID A-A-50560, Service A. Pump casing and flange shall be made of close-grained cast iron. Shaft shall be carbon or alloy steel with lubricated bearings and impeller shall be bronze. Select pumps so that the operating point on selected impeller-curve will lie at or to the left of shutoff side of, and not more than 5 percent below, point of maximum efficiency for impeller. Provide motors of open type conforming to NEMA MG 1 and suitable for electrical characteristic as indicated. Circulating pump motors shall be ECM type.

2.3.3 Expansion Tanks

Provide welded steel, constructed and tested hydrostatically in accordance with ASME BPVC SEC VIII D1. Tank shall be equipped with all necessary fittings. The tank and fittings shall be pressure rated at least equal to the test pressure of the total system. Zinc coat the tank inside and out after fabrication by the hot dip process ASTM A123/A123M.

2.3.4 External Air Separation Tanks

Provide tank constructed of steel, designed for not less than 75 psig, and constructed and tested in accordance with the requirements of ASME BPVC SEC VIII D1. Provide tangential inlet and outlet connections, flanged for sizes 2 1/2 inches and larger. Each unit shall have an internal design suitable for creating the required vortex and subsequent air separation. Provide with automatic air release device and galvanized steel strainer. Provide a blow down connection with a gate valve and piped to nearest floor drain.

2.4 ELECTRICAL EQUIPMENT

Provide complete with motors, motor starters, thermal overload protection, and controls. Equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.5 CONTROLS

Provide controls as specified in SECTION 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC, Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 93 SEQUENCES OF OPERATION FOR HVAC CONTROL, and Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

2.6 INSULATION

Provide shop and field applied insulation as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.7 ASBESTOS PROHIBITION

Asbestos and asbestos containing products are prohibited.

PART 3 EXECUTION

3.1 PREPARATION

Provide storage for equipment and material at the project site. All parts shall be readily accessible for inspection, repair, and renewal. Protect material and equipment from the weather.

3.2 INSTALLATION

Piping fabrication, assembly, welding, soldering, and brazing shall conform to ASME B31.9. Piping shall follow the general arrangement shown. Route piping and equipment within buildings out of the way of lighting fixtures and doors, windows, and other openings. Run overhead piping in buildings in inconspicuous positions. Provide adequate clearances from walls, ceilings, and floors to permit welding of joints and application of insulation. Make provision for expansion and contraction of pipe lines. Make changes in size of water lines with reducing fittings. Do not bury, conceal, or insulate until piping has been inspected, tested, and approved. Do not run piping concealed in walls, partitions, underground, or under the floor except as otherwise indicated. Where pipe passes through building structure, locate pipe joints and expansion joints where they may be inspected. Provide flanged joints where necessary for normal maintenance and where required to match valves and equipment. Furnish gaskets, packing, and thread compounds suitable for the service. Provide long radius ells where possible to reduce pressure drops. Pipe bends in lieu of welding fittings may be used where space permits. Pipe bends shall have a uniform radius of at least five times the pipe diameter and shall be free from appreciable flattening, wrinkling, or thinning of the pipe. Do not use mitering of pipe to form elbows, notching straight runs to form full sized tees, or any similar construction. Make branch connections over 2 inches with welding tees except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ASME B31.9 may be used, provided the nominal diameter of the branch is at least one pipe size less than the nominal diameter of the run. Branch connections 2 inches and under can be threaded or welded. Run vertical piping plumb and straight and parallel to walls. Provide sleeves for lines passing through building structure. Provide a fire seal where pipes pass through fire wall, fire partitions, fire rated pipe chase walls, or floors above grade. Install piping connected to equipment with flexibility for thermal stresses and for vibration, and support and anchor so that strain from weight and thermal movement of piping is not imposed on the equipment.

3.2.1 Hangers and Supports

Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP-58. Band and secure insulation protection shields without damaging pipe insulation. Continuous inserts and expansion bolts may be used.

3.2.2 Grading of Pipe Lines

Unless otherwise indicated, install horizontal lines of hot water piping

to grade down in the direction of flow with a pitch of not less than one inch in 30 feet, except in loop mains and main headers where the flow may be in either direction.

3.2.3 Pipe Sleeves

Provide sleeves where pipes and tubing pass through masonry or concrete walls, floors, roof, and partitions. Annular space between pipe, tubing, or insulation and the sleeve shall not be less than 1/4 inch. Hold sleeves securely in proper position and location before and during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, or slabs. Sleeves in floor slabs shall extend 2 inches above finished floor. Firmly pack space between pipe or tubing and sleeve with oakum and caulk on both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material.

3.2.4 Flashing for Buildings

Provide flashing where pipes pass through building roofs, and make outside walls tight and waterproof.

3.2.5 Unions and Flanges

Provide unions and flanges to permit easy disconnection of piping and apparatus. Each connection having a screwed-end valve shall have a union. Place unions and flanges no farther apart than 100 feet. Install unions downstream of valves and at equipment or apparatus connections. Provide unions on piping under 2 inches in diameter, and provide flanges on piping 2 inches and over in diameter. Provide dielectric unions or flanges between ferrous and non-ferrous piping, equipment, and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous-to-ferrous or non-ferrous-to-non-ferrous connections.

3.2.6 Connections for Future Equipment

Locate capped or plugged outlets for connections to future equipment as indicated.

3.2.7 Changes in Pipe Size

Provide reducing fittings for changes in pipe size; reducing bushings are not permitted. In horizontal lines, provide eccentric reducing fittings to maintain the top of the lines in the same plane.

3.2.8 Cleaning of Pipe

Thoroughly clean each section of pipe, fittings, and valves free of foreign matter before erection. Prior to erection, hold each piece of pipe in an inclined position and tap along its full length to loosen sand, mill scale and other foreign matter. For pipe 2 inches and larger, draw wire brush, of a diameter larger than that of the inside of the pipe, several times through the entire length of pipe. Before making final connections to apparatus, wash out interior of piping thoroughly with water. Plug or cap open ends of mains during shutdown periods. Do not leave lines open where foreign matter might enter the pipe.

3.2.9 Valves

Install valves in conformance with ASME B31.9. Provide gate valves unless otherwise directed. Install valves with stems horizontal or above. Locate or equip stop valves to permit operation from floor level, or provide with safe access in the form of walkways or ladders. Install valves in positions accessible for operation and repair.

3.2.9.1 Radiators Valves

Provide radiator valves on water inlet and balancing valves on water outlet of terminal heating units such as radiation, unit heaters, and fan coil unit.

3.2.9.2 Relief Valves

Provide valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks. Select system relief valve so that capacity is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment. Pipe relief valve outlet to the nearest floor drain.

3.2.10 Pressure Gage

Provide a shut-off valve or pet cock between pressure gages and the line.

3.2.11 Thermometers

Provide thermometers and thermal sensing elements of control valves with a separable socket. Install separable sockets in pipe lines in such a manner to sense the temperature of flowing the fluid and minimize obstruction to flow.

3.2.12 Strainers

Provide strainers, with meshes suitable for the services, where indicated, or where dirt might interfere with the proper operation of valve parts, orifices, or moving parts of equipment.

3.2.13 Pumps

Select pumps for specified fluid temperatures, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve. Support piping adjacent to pump such that no weight is carried on pump casings. Install close coupled and base mounted pumps on concrete base, with anchor bolts, set and level, and grout in place and provide supports under elbows on pump suction and discharge line sizes 4 inches and over. Lubricate pump before start-up.

3.2.14 Equipment Foundations

Locate equipment foundations as shown on the drawings. Size, weight, and design shall preclude shifting of equipment under operating conditions. Foundations shall meet the requirements of the equipment manufacturer. Concrete shall conform to Section 03 30 00 CAST-IN-PLACE CONCRETE, and grout shall be approved non-shrinking.

3.2.15 Equipment Installation

Install equipment in accordance with installation instructions of the manufacturers. Grout equipment mounted on concrete foundations before installing piping. Install piping in such a manner as not to place a strain on the equipment. Do not bolt flanged joints tight unless they match. Grade, anchor, guide, and support piping without low pockets.

3.2.16 Cleaning of Systems

As installation of the various system components is completed, fill, start, and vent prior to cleaning. Place terminal control valves in open position. Add cleaner to closed system at concentration as recommended by manufacturer. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water. Circulate for 6 hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed. Use neutralizer agents on recommendation of system cleaner supplier and approval of Contracting Officer. Remove, clean, and replace strainer screens. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required. Preliminary or final tests are not permitted until cleaning is approved.

3.2.17 Painting of Piping and Equipment

Provide in accordance with Section 09 90 00 PAINTS AND COATINGS.

3.2.18 Identification of Piping

Identify piping in accordance with OSHA 29 CFR 1910.144, except that labels or tapes may be used in lieu of painting or stenciling. Spacing of identification marking on runs shall not exceed 50 feet. Materials for labels and tapes shall conform to CID A-A-1689, and shall be general purpose type and color class. Painting and stenciling shall conform to Section 09 90 00 PAINTS AND COATINGS.

3.3 FIELD QUALITY CONTROL

Perform inspections and tests as specified herein to demonstrate that piping and equipment, as installed, is in compliance with contract requirements. Start up and operate the system. During this time, periodically clean the various strainers until no further accumulation of foreign material occurs. Exercise care so that minimum loss of water occurs when strainers are cleaned. Adjust safety and automatic control instruments to place them in proper operation and sequence.

3.3.1 Hydrostatic Test of Piping System

Test piping system hydrostatically using water not exceeding 100 degrees F. Conduct tests in accordance with the requirements of ASME B31.9 and as follows. Test piping system after all lines have been cleaned and before applying insulation covering. Remove or valve off from the system, gages, and other apparatus which may be damaged by the test before the tests are made. Install calibrated test pressure gage in the system to observe any loss in pressure. Maintain test pressure for a sufficient length of time to enable an inspection of each joint and connection. Perform tests after installation and prior to acceptance. Notify the Contracting Officer in

writing 14 days prior to the time scheduled for the tests.

3.3.2 Auxiliary Equipment and Accessory Tests

Observe and check pumps, accessories, and equipment during operational and capacity tests for leakage, malfunctions, defects, noncompliance with referenced standards, or overloading.

3.4 TESTING, ADJUSTING, AND BALANCING

Except as specified herein, perform in accordance with SMACNA 1780, Chapter VIII "Hydronic System TAB Procedures," drawings and specifications; prepare complete report of final test results. Test, adjust, and balance the hydronic system in accordance with Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC.

3.4.1 Markings of Settings

Following final acceptance of the balancing report, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked so that adjustment can be restored if disturbed at anytime.

-- End of Section --

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SECTION 23 25 00

CHEMICAL TREATMENT OF WATER FOR MECHANICAL SYSTEMS
05/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B40.100 (2013) Pressure Gauges and Gauge
Attachments

ASTM INTERNATIONAL (ASTM)

ASTM D596 (2001; R 2018) Standard Guide for
Reporting Results of Analysis of Water

ASTM D2688 (2015; E 2016) Standard Test Method for
Corrosivity of Water in the Absence of
Heat Transfer (Weight Loss Methods)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Chemical Feeder; G

Water Analysis; G

Spare Parts

Field Instructions

Tests; G

Training Course; G

1.3 MAINTENANCE MATERIAL SUBMITTALS

Submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings, not later than 1 month prior to the date of beneficial occupancy. Include a complete list of

parts and supplies, with source of supply, with the data.

1.4 QUALITY CONTROL

1.4.1 Safety

Ensure exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel are insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices so that proper operation of equipment is not impaired.

1.4.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Summary

This section covers the provisions and installation procedures necessary for a complete and totally functional water system(s) chemical treatment. Provide and install the system with all necessary System Components, Accessories, Piping Components, and Supplemental Components/Services.

2.1.2 Standard Products

- a. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship and that have been in satisfactory commercial or industrial use for two years' prior to bid opening.
- b. Include in the two-year use all applications of equipment and materials under similar circumstances and of similar size. Ensure the two years' experience has been satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a two-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown.
- c. All products are required to be supported by a service organization. Submit a certified list of qualified permanent service organizations for support of the equipment, including their addresses and qualifications. These service organizations are required to be

reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

2.1.3 Water Analysis

Conditions of make-up water to be supplied to the boilers system reported in accordance with ASTM D596 are as follows:

Date of Sample	_____
Temperature	_____ degrees F
Silica (SiO ₂)	_____ ppm (mg/L)
Insoluble	_____ ppm (mg/L)
Iron, total (Fe)	_____ ppm (mg/L)
Aluminum (Al)	_____ ppm (mg/L)
Calcium (Ca)	_____ ppm (mg/L)
Magnesium (Mg)	_____ ppm (mg/L)
Carbonate (HCO ₃)	_____ ppm (mg/L)
Sulfate (SO ₄)	_____ ppm (mg/L)
Chloride (Cl)	_____ ppm (mg/L)
Nitrate (NO ₃)	_____ ppm (mg/L)
Turbidity	_____ ntu
pH	_____
Residual Chlorine	_____ ppm (mg/L)
Total Alkalinity	_____ ppm (mg/L)
Non-Carbonate Hardness	_____ ppm (mg/L)
Total Hardness	_____ ppm (mg/L)
Dissolved Solids	_____ ppm (mg/L)
Conductivity	_____ Micromho/cm

2.2 EQUIPMENT

2.2.1 Nameplates

Provide a nameplate for each major component of equipment that includes the manufacturer's name, address, type or style, and catalog or serial number securely attached to the item of equipment. Provide nameplates for:

- a. Pump(s)
- b. Pump Motor(s)
- c. Water Treatment Controller(s)

2.2.2 Electrical Work

Ensure all electrical equipment, motors, motor efficiencies, and wiring complies with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide electrical motor driven equipment specified complete with motors, motor starters, and controls. Provide electrical characteristics and enclosure types as shown, and unless otherwise indicated, provide all motors of 1 horsepower and above with open, drip-proof, or totally enclosed fan cooled enclosures, high efficiency type. Perform field wiring in accordance with manufacturer's instructions. Each motor is required to conform to NEMA MG 1 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Provide continuous duty motors with the enclosure specified. Provide motor starters complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Furnish motors with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Furnish motor starters with NEMA 3R enclosures. Provide manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown.

2.2.3 Gauges

Provide gauges that conform to ASME B40.100, Class 1, 2, or 3, Style X, Type I or III as required, 4-1/2 inches in diameter with phenolic or metal case.

2.3 COMPONENTS

2.3.1 Low and Medium Temperature Hot Water Boilers and Heat Exchangers

Low and medium temperature hot water boilers are defined as those operating below 350 degrees F, (250 degrees F for Low Temperature).

2.3.1.1 Chemical Feeder

Provide a 2 gallon shot feeder on the hot water piping as indicated. Base the size and capacity of feeder upon local requirements and water analysis. Furnish the feeder with an air vent, gauge glass, funnel, valves, fittings, and piping.

2.3.1.2 Low and Medium Temperature Hot Water Treatment

Treat hot water with either a borax/nitrite type treatment or a molybdate type treatment. Both types of treatment are acceptable to use with glycol. Maintain borax/nitrite treatment at the limits of 600 to 1000 ppm nitrite, 40 - 50 ppm copper corrosion inhibitor (TT or MBT) and pH of 8.5 to 9.5. Maintain molybdate treatment at the limits of 100 to 125 ppm molybdate, 40 - 50 ppm copper corrosion inhibitor (TT or MBT) and pH of 8.0 to 9.0.

2.3.2 Test Kit

Provide one test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals (e.g. pH, hardness and sulfite).

2.3.3 Supplemental Components/Services

Ensure drain and makeup water piping complies with the requirements of Section 22 00 00 PLUMBING, GENERAL PURPOSE. Connect drains to sanitary sewer systems by means of an indirect waste connection.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy, before performing any work.

3.2 INSTALLATION

Provide all chemicals, equipment and labor necessary to bring all system waters in conformance with the specified requirements. Perform all work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

3.2.1 Piping

Fabricate all connections between dissimilar metals using dielectric unions.

3.3 FIELD QUALITY CONTROL

3.3.1 Tests

If the waters of the mechanical systems are not in conformance with the specified requirements or in accordance with manufacturer's recommendations, the contractor is required to direct the water treatment company to take corrective action to achieve compliance. Perform daily operational tests in the directed frequencies to maintain required control to prevent corrosion, scaling and damage to equipment during operation. Submit test schedules, at least 2 weeks prior to the start of related testing, for the condenser/chilled/boiler/condensate/feedwater water quality tests. Identify the date, time, frequency and collection location for each test within the schedules.

3.3.2 Hot Water Boiler Water Quality Testing

3.3.2.1 Low and Medium Temperature Systems (monthly)

Complete and record monthly testing for the following parameters.

pH	_____
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Nitrite or Molybdate	_____ ppm (mg/L)
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3.3.3 Quality Assurance Testing

Conduct QA testing periodically by an independent water treatment lab/consultant to verify to managers that the mechanical and water treatment systems are being maintained properly. Provide the QA evaluation reports to the government COR.

3.3.3.1 Hot Water Boiler Water Quality Assurance Testing

- a. Complete quarterly testing of Low and Medium Temperature Systems and record the following parameters.

pH	_____
Nitrite or Molybdate	_____ ppm (mg/L)
Iron (total, as Fe(2)O(3))	_____ ppm (mg/L)
Written evaluation summary	

- b. Have an independent consultant analyze the hot water boiler water once a month for a period of 1 year. Include the following information recorded in accordance with ASTM D596 in the monthly report.

pH	_____
Sulfite (Na2SO3)	_____ ppm (mg/L)
Hardness(as CaCO3)	_____ ppm (mg/L)
Iron (total, as Fe(2)O(3))	_____ ppm (mg/L)
Written evaluation summary	

3.3.4 Corrosion Testers

Install corrosion coupon and rack systems to verify corrosion control in the systems. Install testers or coupons in flowing system water through a sidestream or rack system. Test both mild steel and copper metal samples in the corrosion testers in accordance with ASTM D2688. Replace and analyze samples every 3 months. Rates of corrosion less than 3 mpy for steel and 0.2 mpy for copper are acceptable. Install corrosion testers on the piping systems of the following systems.

Hot water loop

3.4 CLOSEOUT ACTIVITIES

3.4.1 Training Course

Submit a schedule, at least 2 weeks prior to the date of the proposed training course that identifies the date, time, and location for the training. Conduct a training course for the operating staff as designated by the Contracting Officer. Conduct the training to include a total of 4 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. Submit field instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. Include within the condensed operation instructions all preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. Frame the posted instructions under glass or laminated plastic and post where indicated by the Contracting Officer. Ensure the field instructions cover all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations.

3.5 INSPECTIONS

3.5.1 Inspection General Requirements

Thirty days after project completion, inspect the cooling tower and condenser for problems due to corrosion, scale, and biological growth. If the cooling tower and condenser are found not to conform to the manufacturer's recommended conditions, and the water treatment company recommendations have been followed; instruct the water treatment company to provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

3.5.2 Boiler/Piping Test

Thirty days after project completion, inspect the boiler and condensate piping for problems due to corrosion and scale. If the boiler is found not to conform to the manufacturer's recommendations, and the water treatment company recommendations have been followed, instruct the water treatment company to provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations. If corrosion is found within the condensate piping, proper repairs are required to be made by the water treatment company at no additional cost.

-- End of Section --

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SECTION 23 30 00

HVAC AIR DISTRIBUTION
05/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 99-0401	(1986) Classifications for Spark Resistant Construction
AMCA 201	(2002; R 2011) Fans and Systems
AMCA 210	(2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(2014) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(2014) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D	(2018) Laboratory Methods of Testing Dampers for Rating

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 410	(2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI 880 I-P	(2011) Performance Rating of Air Terminals
AHRI 885	(2008; Addendum 2011) Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
AHRI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(2015) Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	(2014) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

- ASHRAE 52.2 (2012) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
- ASHRAE 62.1 (2013) Ventilation for Acceptable Indoor Air Quality
- ASHRAE 70 (2006; R 2011) Method of Testing for Rating the Performance of Air Outlets and Inlets

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- ASME A13.1 (2020) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

- ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- ASTM A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A167 (2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- ASTM A924/A924M (2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- ASTM B117 (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
- ASTM B152/B152M (2019) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
- ASTM B209 (2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- ASTM B766 (1986; R 2015) Standard Specification for Electrodeposited Coatings of Cadmium
- ASTM C553 (2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- ASTM D520 (2000; R 2011) Zinc Dust Pigment
- ASTM D1654 (2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive

Environments

ASTM D3359 (2017) Standard Test Methods for Rating
Adhesion by Tape Test

ASTM E2016 (2020) Standard Specification for
Industrial Woven Wire Cloth

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350 (2010; Version 1.1) Standard Method for
the Testing and Evaluation of Volatile
Organic Chemical Emissions from Indoor
Sources using Environmental Chambers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

NEMA MG 10 (2017) Energy Management Guide for
Selection and Use of Fixed Frequency
Medium AC Squirrel-Cage Polyphase
Induction Motors

NEMA MG 11 (1977; R 2012) Energy Management Guide for
Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2021) Standard for the Installation of
Air Conditioning and Ventilating Systems

NFPA 701 (2019) Standard Methods of Fire Tests for
Flame Propagation of Textiles and Films

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA 1819 (2002) Fire, Smoke and Radiation Damper
Installation Guide for HVAC Systems, 5th
Edition

SMACNA 1966 (2005) HVAC Duct Construction Standards
Metal and Flexible, 3rd Edition

SMACNA 1981 (2008) Seismic Restraint Manual Guidelines
for Mechanical Systems, 3rd Edition

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82 Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 6 (2007; Reprint Sep 2019) UL Standard for

Safety Electrical Rigid Metal Conduit-Steel

UL 181	(2013; Reprint Apr 2017) UL Standard for Safety Factory-Made Air Ducts and Air Connectors
UL 555	(2006; Reprint Aug 2016) UL Standard for Safety Fire Dampers
UL 555S	(2014; Reprint Oct 2020) UL Standard for Safety Smoke Dampers
UL 586	(2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units
UL 705	(2017; Reprint Oct 2018) UL Standard for Safety Power Ventilators
UL 900	(2015) Standard for Air Filter Units
UL 1995	(2015) UL Standard for Safety Heating and Cooling Equipment
UL Bld Mat Dir	(updated continuously online) Building Materials Directory
UL Fire Resistance	(2014) Fire Resistance Directory

1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Mechanical Equipment Identification

The number of charts and diagrams must be equal to or greater than the number of mechanical equipment rooms. Where more than one chart or diagram per space is required, mount these in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

1.2.1.1 Charts

Provide chart listing of equipment by designation numbers and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, horsepower, pipe sizes, and voltage and current characteristics.

1.2.1.2 Diagrams

Submit proposed diagrams, at least 2 weeks prior to start of related testing. provide neat mechanical drawings provided with extruded aluminum frame under 1/8-inch glass or laminated plastic, system diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods

of checking the system for normal, safe operation, and procedures for safely starting and stopping the system. After approval, post these items where directed.

1.2.2 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Provide labels in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Rooftop air handling unit Number	RTU - #
Exhaust Fan Number	EF - #
VAV Box Number	VAV - #

Identify similar services with different temperatures or pressures. Where pressures could exceed 125 pounds per square inch, gage, include the maximum system pressure in the label. Label and arrow piping in accordance with the following:

- Each point of entry and exit of pipe passing through walls.
- Each change in direction, i.e., elbows, tees.
- In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.
- In long straight runs, locate labels at distances within eyesight of each other not to exceed 75 feet. All labels must be visible and legible from the primary service and operating area.

For Bare or Insulated Pipes	
for Outside Diameters of	Lettering
1/2 thru 1-3/8 inch	1/2 inch
1-1/2 thru 2-3/8 inch	3/4 inch
2-1/2 inch and larger	1-1/4 inch

1.2.3 Color Coding

Color coding of all piping systems must be in accordance with ASME A13.1.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Insulated Nonmetallic Flexible Duct Runouts

Duct Connectors

Duct Access Doors; G

Fire Dampers; G

Manual Balancing Dampers; G

Automatic Smoke-Fire Dampers; G

Automatic Smoke Dampers; G

Diffusers

Registers and Grilles

Louvers

Air Vents, Penthouses, and Goosenecks

Centrifugal Fans

In-Line Centrifugal Fans

High Volume, Low Speed Fans (HVLS); G

Variable Volume, Single Duct Terminal Units; G

Diagrams; G

Indoor Air Quality for Duct Sealants; S

Low Leakage Barometric Relief Damper; G

Linear Diffusers; G

Boiler Flue Vent; G

Upblast Centrifugal Fan; G

SD-06 Test Reports

Performance Tests; G

Damper Acceptance Test; G

SD-07 Certificates

Ozone Depleting Substances Technician Certification

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions

Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Fire Dampers; G

Manual Balancing Dampers; G

Automatic Smoke-Fire Dampers; G

Rooftop Air Handling Units; G

Variable Volume, Single Duct Terminal Units; G

High Volume, Low Speed Fans (HVLS); G

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

- a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.
- b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.
- c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.
- d. Where products are specified to meet or exceed the specified energy efficiency requirement of FEMP-designated or ENERGY STAR covered product categories, equipment selected must have as a minimum the efficiency rating identified under "Energy-Efficient Products" at <http://femp.energy.gov/procurement>.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Provide 316 stainless steel parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials in accordance with ASTM A123/A123M for exterior locations and cadmium-plated in conformance with ASTM B766 for interior locations.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting refrigerants must be certified as a Section 608 Technician to meet requirements in 40 CFR 82, Subpart F. Provide copies of technician certifications to the Contracting Officer at least 14 calendar days prior to work on any equipment containing these refrigerants.

1.4.4 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

1.6 WARRANTY

Warranty shall commence following government acceptance of functional performance testing.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function

of the equipment. Submit designation with the shop drawings. Provide identification plates that are layers, black-white-black, engraved to show white letters on black background. Letters must be upper case. Identification plates that are 1-1/2-inches high and smaller must be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high must be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger must have beveled edges. Install identification plates using a compatible adhesive.

2.2 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard. The requirements for catwalks, operating platforms, ladders, and guardrails are specified in Section 08 31 00 ACCESS DOORS AND PANELS.

2.3 ELECTRICAL WORK

- a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.
- b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Provide premium efficiency type integral size motors in accordance with NEMA MG 1.
- c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.
- d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.
- e. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers are allowed to accomplish the same

function. Use solid-state variable-speed controllers for motors rated 10 hp or less and adjustable frequency drives for larger motors. Provide variable frequency drives for motors as specified in Section 26 29 23 ADJUSTABLE SPEED DRIVE SYSTEMS UNDER 600 VOLTS. Provide inverter-ready motors meeting NEMA MG 1 Part 31 for motors with variable frequency drives. Provide split-shaft grounding rings for all motors with variable frequency drives.

- f. Magnetic motor starters shall be enclosed in a general purpose electrical enclosure with the appropriate environmental rating. Starters shall consist of a horsepower rated magnetic contactor with a minimum of one Normally Open and one Normally Closed auxiliary contacts and solid state electronic overload relay. Overload relay shall protect all three phases with a wide range current setting and trip class to allow field adjustment for specific motor FLA. Interchangeable heater elements are not acceptable. Overload relay shall provide phase failure, phase loss, locked rotor and stall protection. Provide a manual reset push-button on the starter cover to restore normal operation after a trip or fault condition. Each starter shall include an installed control power transformer with protected secondary. Installed accessories shall include Hand-Off-Auto operation switch or push button. Include LED pilot light indicators for Hand, Off, Auto, Run and Overload conditions. All pilot devices shall be water tight and dust tight. The starter or combination starter shall be UL Listed.
- g. Starter shall include remote run terminals which accept both a voltage input signal and a contact closure. The voltage run input shall accept both AC and DC signals including 24VAC, 120VAC, 24VDC, and 240VAC to allow direct connection of the transistorized automation signal to the starter. As indicated on drawings where the motor is interlocked with a damper or valve, the actuator control must reside within the starter enclosure. The starter must provide a voltage output to operate the actuator to open the damper or valve without closing the motor circuit. The starter will only close the motor circuit and start the motor after it has received a contact closure from a limit or end switch confirming the damper or valve position. Manufacturer shall provide and install tags with engraved white lettering to designate equipment served.

2.4 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts must not degrade the surrounding concrete.

2.5 SEISMIC ANCHORAGE

Anchor equipment in accordance with applicable seismic criteria for the area and as defined in SMACNA 1981

2.6 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

2.7 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.8 DUCT SYSTEMS

2.8.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification.

- a. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.
- b. Provide ductwork that meets the requirements of Seal Class A. Provide ductwork in VAV systems upstream of the VAV boxes that meets the requirements of Seal Class A.
- c. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant. Provide duct sealant products that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants are classified as "Other" within the SCAQMD Rule 1168 sealants table). Provide validation of indoor air quality for duct sealants.
- d. Make spiral lock seam duct, and flat oval with duct sealant and lock with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable.
- e. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

2.8.1.1 Insulated Nonmetallic Flexible Duct Runouts

Use flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 5 feet. Provide runouts that are preinsulated, factory fabricated, and that comply with NFPA 90A and UL 181. Provide either field or factory applied vapor barrier. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene. Where coil induction or high velocity units are supplied with vertical air inlets, use a streamlined, vaned and mitered elbow transition piece for connection to the flexible duct or hose. Provide a die-stamped elbow and not a flexible connector as the last elbow to these units other than the vertical air inlet type. Insulated flexible connectors are allowed as runouts. Provide insulated material and vapor barrier that conform to the requirements of Section 23 07 00 THERMAL

INSULATION FOR MECHANICAL SYSTEMS. Do not expose the insulation material surface to the air stream.

2.8.1.2 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with NFPA 701 and is classified as "flame-retardent fabrics" in UL Bld Mat Dir.

2.8.1.3 Aluminum Ducts

ASTM B209, alloy 3003-H14 for aluminum sheet and alloy 6061-T6 or equivalent strength for aluminum connectors and bar stock.

2.8.1.4 Copper Sheets

ASTM B152/B152M, light cold rolled temper.

2.8.1.5 Corrosion Resisting (Stainless) Steel Sheets

ASTM A167. Combustion Air Intake and flue ducts shall be stainless steel.

2.8.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.8.3 Fire Dampers

Use 1.5 hour rated fire dampers unless otherwise indicated. Provide fire dampers that conform to the requirements of NFPA 90A and UL 555. Perform the fire damper test as outlined in NFPA 90A. Provide a pressure relief door upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then provide a factory installed pressure relief damper. Provide automatic operating fire dampers with a dynamic rating suitable for the maximum air velocity and pressure differential to which it is subjected. Provide fire dampers approved for the specific application, and install according to their listing. Equip fire dampers with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, does not impair the operation of the damper. Equip sleeves or frames with perimeter mounting angles attached on both sides of the wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies in conformance with UL Fire Resistance. Provide curtain type with damper blades out of the air stream fire dampers. Install dampers that do not reduce the duct or

the air transfer opening cross-sectional area. Install dampers so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, comply with the installation details given in SMACNA 1819 and in manufacturer's instructions for fire dampers. Perform acceptance testing of fire dampers according to paragraph Fire Damper Acceptance Test and NFPA 90A. Provide switch package for fire dampers to communicate the damper position (full open or full closed) of the blades to the building control system specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

2.8.4 Automatic Smoke-Fire Dampers

Multiple blade type, 180 degrees F fusible fire damper link; smoke damper assembly to include 120 volt electric damper operator. UL 555 as a 1.5 hour rated fire damper; further qualified under UL 555S as a leakage rated damper. Provide a leakage rating under UL 555S that is no higher than Class I at an elevated temperature Category B (250 degrees F for 30 minutes). Ensure that pressure drop in the damper open position does not exceed 0.1 inch water gauge with average duct velocities of 2500 fpm. Provide switch package for smoke-fire dampers to communicate the damper position (full open or full closed) of the blades to the building control system specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

2.8.5 Automatic Smoke Dampers

UL listed multiple blade type, supplied by smoke damper manufacturer, with 120 volt electric damper operator as part of assembly. Qualified under UL 555S with a leakage rating no higher than Class I at an elevated temperature Category B (250 degrees F for 30 minutes). Ensure that pressure drop in the damper open position does not exceed 0.1 inch water gauge with average duct velocities of 2500 fpm. Provide switch package for smoke dampers to communicate the damper position (full open or full closed) of the blades to the building control system specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

2.8.6 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

2.8.7 Manual Balancing Dampers

- a. Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators.

- b. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide access doors or panels in hard ceilings, partitions and walls for access to all concealed damper operators and damper locking setscrews. Coordinate location of doors or panels with other affected contractors.
- c. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

2.8.7.1 Square or Rectangular Dampers

2.8.7.1.1 Duct Height 12 inches and Less

2.8.7.1.1.1 Frames

Width	Height	Galvanized Steel Thickness	Length
Maximum 19 inches	Maximum 12 inches	Minimum 20 gauge	Minimum 3 inches
More than 19 inches	Maximum 12 inches	Minimum 16 gauge	Minimum 3 inches

2.8.7.1.1.2 Single Leaf Blades

Width	Height	Galvanized Steel Thickness	Length
Maximum 19 inches	Maximum 12 inches	Minimum 20 gauge	Minimum 3 inches
More than 19 inches	Maximum 12 inches	Minimum 16 gauge	Minimum 3 inches

2.8.7.1.1.3 Blade Axles

To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Provide axle shafts that extend through standoff bracket and hand quadrant.

Width	Height	Material	Square Shaft
Maximum 19 inches	Maximum 12 inches	Galvanized Steel	Minimum 3/8 inch
More than 19 inches	Maximum 12 inches	Galvanized Steel	Minimum 1/2 inch

2.8.7.1.1.4 Axle Bearings

Support the shaft on each end at the frames with shaft bearings. Press fit shaft bearings configuration to provide a tight joint between blade shaft and damper frame.

Width	Height	Material
Maximum 19 inches	Maximum 12 inches	solid nylon, or equivalent solid plastic, or oil-impregnated bronze
More than 19 inches	Maximum 12 inches	oil-impregnated bronze

2.8.7.1.1.5 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Provide a minimum stand-off distance of 2 inches off the metal duct surface. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

2.8.7.1.1.6 Finish

Mill Galvanized

2.8.7.1.2 Duct Height Greater than 12 inches

2.8.7.1.2.1 Dampers

Provide dampers with multi-leaf opposed-type blades.

2.8.7.1.2.2 Frames

Maximum 48 inches in height; maximum 48 inches in width; minimum of 16 gauge galvanized steel, minimum of 5 inches long.

2.8.7.1.2.3 Blades

Minimum of 16 gauge galvanized steel; 6 inch nominal width.

2.8.7.1.2.4 Blade Axles

To support the blades of round dampers, provide galvanized square steel shafts supporting the blade the entire duct diameter frame-to-frame. Provide axle shafts that extend through standoff bracket and hand quadrant.

2.8.7.1.2.5 Axle Bearings

Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, or solid nylon, or a solid plastic equivalent to nylon. Press fit shaft bearings configuration to provide a tight joint between blade shaft and damper frame.

2.8.7.1.2.6 Blade Actuator

Minimum 1/2 inch diameter galvanized steel.

2.8.7.1.2.7 Blade Actuator Linkage

Mill Galvanized steel bar and crank plate with stainless steel pivots.

2.8.7.1.2.8 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Provide a minimum stand-off distance of 2 inches off the metal duct surface. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

2.8.7.1.2.9 Finish

Mill Galvanized

2.8.7.2 Round Dampers

2.8.7.2.1 Frames

Size	Galvanized Steel Thickness	Length
4 to 20 inches	Minimum 20 gauge	Minimum 6 inches
22 to 30 inches	Minimum 20 gauge	Minimum 6 inches
32 to 40 inches	Minimum 16 gauge	Minimum 6 inches

2.8.7.2.2 Blades

Size	Galvanized Steel Thickness
4 to 20 inches	Minimum 20 gauge
22 to 30 inches	Minimum 16 gauge

Size	Galvanized Steel Thickness
32 to 40 inches	Minimum 10 gauge

2.8.7.2.3 Blade Axles

To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Provide axle shafts that extend through standoff bracket and hand quadrant.

Size	Shaft Size and Shape
4 to 20 inches	Minimum 3/8 inch square
22 to 30 inches	Minimum 1/2 inch square
32 to 40 inches	Minimum 3/4 inch square

2.8.7.2.4 Axle Bearings

Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, nylon, or a solid plastic equivalent to nylon. Axle bearings intended for low leakage at the damper frame must be neoprene, nitrile, or equivalent of 60 or greater durometer to reduce damper blade vibration. Press fit shaft bearings configuration to provide a tight joint between blade shaft and damper frame.

Size	Material
4 to 20 inches	solid nylon, or equivalent solid plastic, or oil-impregnated bronze
22 to 30 inches	solid nylon, or equivalent solid plastic, or oil-impregnated bronze
32 to 40 inches	oil-impregnated bronze, or stainless steel sleeve bearing

2.8.7.2.5 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Provide a minimum stand-off distance of 2 inches off the metal duct surface. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

2.8.7.2.6 Finish

Mill Galvanized

2.8.8 Low Leakage Barometric Relief Damper

Dampers shall consist of: 16 gauge insert mount galvanized steel channel frame with 5 inch depth; blades from 0.063 inches thick formed aluminum, eccentrically pivoted; 3/8 inch square plated steel axles with galvanized steel press-fit ball bearings; damper shall be equipped with pressure activated TPE blade seals; and internal plated steel blade-to-blade linkage with blade mounted counterbalance weights. Damper shall be suitable for pressures to 2 inch wg, velocities to 2000 fpm, and temperatures to 180 degrees F. Testing and ratings to be in accordance with AMCA 500-D.

2.8.9 Plenums

2.8.9.1 Plenum

Fabricate and erect plenums as shown in SMACNA 1966, as applicable. Construct of not less than 16 gauge galvanized sheet steel. Fabricate drain pans from 18 gauge corrosion-resisting sheet steel conforming to ASTM A167, Type 304, welded and stiffened. Seal openings to meet Seal Class A.

2.8.9.2 Casing

Terminate casings at the curb line and bolt each to the curb using galvanized angle, as indicated in SMACNA 1966.

2.8.9.3 Access Doors

Provide access doors in each section of the plenum. Weld doorframes in place, gasket each door with neoprene, hinge with minimum of two brass hinges, and fasten with a minimum of two brass tension fasteners operable from inside and outside of the casing. Where possible, make doors 36 by 18 inches and locate them 18 inches above the floor. Where the space available does not accommodate doors of this size, use doors as large as the space accommodates. Swing doors so that fan suction or pressure holds doors in closed position, airtight. Provide a push-button station, located inside the casing, to stop the supply.

2.8.9.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components are allowed for field-assembled units, provided all requirements specified for field-fabricated plenums and casings are met. Provide panels of modular design, pretested for structural strength, thermal control, condensation control, and acoustical control. Seal and insulate panel joints. Provide and gasket access doors to prevent air leakage. Provide panel construction that is not less than 20 gauge galvanized sheet steel, assembled with fasteners treated against corrosion. Provide standard length panels that deflect not more than 1/2 inch under operation. Construct details, including joint sealing, not specifically covered, as indicated in SMACNA 1966. Construct the plenums and casings to withstand the specified internal pressure of the air systems.

2.8.9.5 Duct Liner

Unless otherwise specified, duct liner is not permitted.

2.8.10 Diffusers, Registers, and Grilles

Provide factory-fabricated units of aluminum that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Provide opposed blade type volume dampers for all diffusers and registers, except linear slot diffusers. Provide linear slot diffusers with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

2.8.10.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide return or exhaust units that are similar to supply diffusers.

2.8.10.2 Linear Diffusers

Make joints between diffuser sections that appear as hairline cracks. Provide alignment slots for insertion of key strips or other concealed means to align exposed butt edges of diffusers. Equip with plaster frames when mounted in plaster ceiling. Do not use screws and bolts in exposed face of frames or flanges. Metal-fill and ground smooth frames and flanges exposed below ceiling. Furnish separate pivoted or hinged adjustable air-volume-damper and separate air-deflection blades.

2.8.10.3 Registers and Grilles

Provide registers and grilles as indicated on the drawings. Registers and grilles are to be aluminum and painted white unless otherwise noted. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Install wall supply registers at least 6 inches below the ceiling unless otherwise indicated. Locate return and exhaust registers 6 inches above the floor unless otherwise indicated. Provide grilles as specified for registers, without volume control damper.

2.8.11 Boiler Flue Vent

The vent shall be of the double-wall, factory-built type for use on condensing appliances or pressurized venting systems serving Category IV appliances or as specified by the equipment manufacturer. Vent shall be listed for an internal static pressure of 10-inch w.g. and tested to 25 inch w.g. Vent shall be constructed with an inner and outer wall, with a 1-inch annular insulating air space. The inner wall (vent) shall be constructed of 0.015 thick AL29-4C superferritic stainless steel. Vent shall incorporate factory-installed gaskets. The outer wall (casing) for interior spaces shall be constructed of aluminized steel, 0.018-inch thickness. The outer wall shall be constructed of a minimum 0.012-inch

thick Type 430 stainless steel for parts exposed to the weather. Inner and outer walls shall be connected by means of spacer clips that maintain the concentricity of the annular space and allow unobstructed differential thermal expansion of the inner and outer walls.

All supports, roof, or wall penetrations, terminations, appliance connectors, and drain fittings, required to install the vent system shall be included. Roof penetration pieces shall be UL listed and provided by the vent manufacturer.

Vent shall be secured by sheet metal screws through casings. Joints shall be sealed at flue with factory-installed gaskets. Where exposed to weather, the outer closure band shall be sealed to prevent rainwater from entering the space between inner and outer wall. Vent shall terminate in accordance with Installation Instructions and local codes.

2.8.12 Louvers

Provide louvers for installation in exterior walls that are associated with the air supply and distribution system as specified in Section 08 91 00 METAL WALL LOUVERS.

2.8.13 Air Vents, Penthouses, and Goosenecks

Fabricate air vents, penthouses, and goosenecks from aluminum sheets with or aluminum structural shapes. Provide sheet metal thickness, reinforcement, and fabrication that conform to SMACNA 1966. Accurately fit and secure louver blades to frames. Fold or bead edges of louver blades for rigidity and baffle these edges to exclude driving rain. Provide air vents, penthouses, and goosenecks with bird screen.

2.8.14 Bird Screens and Frames

Provide bird screens that conform to ASTM E2016, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide "light" rated stainless steel screens. Provide removable type frames fabricated from either stainless steel or extruded aluminum.

2.9 AIR SYSTEMS EQUIPMENT

2.9.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans must not exceed 85 dBA when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors either directly or indirectly with V-belt drive. Use V-belt drives designed for not less than 150 percent of the connected driving capacity. Provide variable pitch motor sheaves for 15 hp and below, and fixed pitch as defined by AHRI Guideline D (A fixed-pitch sheave is provided on both the fan shaft and the motor shaft. This is a non-adjustable speed drive.). Select variable pitch sheaves to drive the fan at a speed which can produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide a replaceable sheave when needed to achieve system

air balance. Provide motors for V-belt drives with adjustable rails or bases. Provide removable metal guards for all exposed V-belt drives, and provide speed-test openings at the center of all rotating shafts. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide sound power level as indicated. Obtain the sound power level values according to AMCA 300. Provide standard AMCA arrangement, rotation, and discharge as indicated. Provide power ventilators that conform to UL 705 and have a UL label. Provide AMCA 99-0401 Class A Spark Resistant Construction for fans where scheduled.

2.9.1.1 Centrifugal Fans

Provide fully enclosed, single-width single-inlet, or double-width double-inlet centrifugal fans, with AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Provide impeller wheels that are rigidly constructed and accurately balanced both statically and dynamically. Provide forward curved or backward-inclined airfoil design fan blades in wheel sizes up to 30 inches. Provide backward-inclined airfoil design fan blades for wheels over 30 inches in diameter. Provide fan wheels over 36 inches in diameter with overhung pulleys and a bearing on each side of the wheel. Provide fan wheels 36 inches or less in diameter that have one or more extra long bearings between the fan wheel and the drive. Provide sleeve type, self-aligning and self-oiling bearings with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Connect grease fittings to tubing for serviceability from a single accessible point. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide steel, accurately finished fan shafts, with key seats and keys for impeller hubs and fan pulleys. Provide fan outlets of ample proportions, designed for the attachment of angles and bolts for attaching flexible connections. Unless otherwise indicated, provide motors that do not exceed 1800 rpm and have dripproof enclosures. Provide magnetic across-the-line type motor starters with general-purpose enclosure or variable frequency drive as scheduled.

2.9.1.2 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades, stationary discharge conversion vanes, direct drive. Mount fans in a welded tubular casing. Provide a fan that axially flows the air in and out. Streamline inlets with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide fan constructed of heavy gauge aluminum. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide motors with dripproof enclosure. Provide magnetic motor starters across-the-line with general-purpose enclosures or variable frequency drive as scheduled.

2.9.1.3 Upblast Centrifugal Fan

Provide direct driven centrifugal type fans with backward inclined, non-overloading wheel. Provide hinged or removable and weatherproof motor

compartment housing, constructed of heavy gauge aluminum. Provide fans with birdscreen, disconnect switch, motorized dampers, roof curb. Provide dripproof type motor enclosure.

2.9.1.4 Panel Type Power Wall Ventilators

Provide propeller type fans, assembled on a reinforced metal panel with venturi opening spun into panel. Provide direct or drive with wheels less than 24 inches in diameter and provide V-belt driven fans with wheels 24 inches in diameter and larger. Provide fans with wall mounting collar. Provide lubricated bearings. Equip fans with wheel and motor side metal or wire guards which have a corrosion-resistant finish. Provide dripproof type motor enclosure. Install motor operated backdraft dampers where indicated. Provide fan constructed of heavy gauge aluminum.

2.9.1.5 High Volume, Low Speed Fans (HVLS)

Provide an aluminum blade fan with diameter as indicated on drawings. Fan shall be mounted to structural joists and shall maintain all minimum airflow requirements. Fan motor shall be housed in a NEMA 4X enclosure and be equipped with a variable frequency drive. Provide auxiliary wall-mounted digital keypad with touch controls and an LED display to control the fan's direction, operation, speed and programming. Provide a 24 VDC pilot relay for seamless integration to the fire control panel.

2.9.2 Coils

2.9.2.1 Water Coils

Install water coils with a pitch of not less than 1/8 inch/foot of the tube length toward the drain end. Use headers constructed of cast iron, welded steel or copper. Furnish each coil with a plugged vent and drain connection extending through the unit casing. Provide removable water coils with drain pans. Pressure test coils in accordance with UL 1995.

2.9.3 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586.

2.9.3.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters with a MERV of 8 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.36 inches water gauge. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to the inside of the frame to prevent air bypass and increase rigidity.

2.9.3.2 Cartridge Type Filters

Provide 12 inch depth, sectional, replaceable dry media type filters of the size indicated with a MERV of 13 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.56 inches, water gauge. Provide UL class 1 filters, and pleated microglass paper media with corrugated aluminum separators, sealed inside the filter cell to form a totally rigid filter assembly. Fluctuations in filter face

velocity or turbulent airflow have no effect on filter integrity or performance. Install each filter with an extended surface pleated media panel filter as a prefilter in a factory preassembled side access housing, or a factory-made sectional frame bank, as indicated.

2.10 AIR HANDLING UNITS

Provide Rooftop Air Handling Unit (RTU-1) as specified in Section 23 81 00 Decentralized Unitary HVAC Equipment.

2.11 TERMINAL UNITS

2.11.1 Variable Air Volume (VAV) Terminal Units

- a. Provide VAV terminal units that are the type, size, and capacity shown, mounted in the ceiling or wall cavity, plus units that are suitable for single duct system applications. Provide actuators and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS.
- b. Provide unit enclosures that are constructed of galvanized steel not lighter than 22 gauge or aluminum sheet not lighter than 18 gauge. Provide single or multiple discharge outlets as required. Units with flow limiters are not acceptable. Provide unit air volume that is factory preset and readily field adjustable without special tools. Provide reheat coils as indicated.
- c. Attach a flow chart to each unit. Base acoustic performance of the terminal units upon units tested according to AHRI 880 I-P with the calculations prepared in accordance with AHRI 885. Provide sound power level as indicated. Show discharge sound power for minimum and 1-1/2 inches water gauge inlet static pressure. Provide acoustical lining according to NFPA 90A.
- d. Provide 110- to 24-volt control power transformer and disconnect at each VAV terminal unit for control power.

2.11.1.1 Variable Volume, Single Duct Terminal Units

Provide variable volume, single duct, terminal units with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Provide units that control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Provide units with an internal resistance not exceeding 0.2 inch water gauge at maximum flow range. Provide external differential pressure taps separate from the control pressure taps for air flow measurement with a 0 to 1 inch water gauge range.

2.11.1.2 Reheat Units

2.11.1.2.1 Hot Water Coils

Provide fin-and-tube type hot-water coils constructed of seamless copper tubes and copper or aluminum fins mechanically bonded or soldered to the tubes. Provide headers that are constructed of cast iron, welded steel or copper. Provide casing and tube support sheets that are 16 gauge, galvanized steel, formed to provide structural strength. Provide tubes that are correctly circuited for proper water velocity without excessive

pressure drop and are drainable where required or indicated. At the factory, test each coil at not less than 250 psi air pressure and provide coils suitable for 200 psi working pressure. Install drainable coils in the air handling units with a pitch of not less than 1/8 inch per foot of tube length toward the drain end. Coils must conform to the provisions of AHRI 410.

2.12 DEHUMIDIFIERS

Provide refrigerated-type commercial grade UL listed dehumidifier. Unit casing shall be metallic and shall be factory painted. Dehumidifier shall have packaged sealed refrigerant system. Dehumidifier shall have a minimum of a replaceable MERV 13 air filter. The unit shall be controlled by a wall mounted external humidistat. The humidistat shall be controlled locally with settings from 20 to 60 percent relative humidity, humidistat shall have local display. Provide with condensate pump kit. Provide factory transformer to comply with scheduled voltage. Provide control panel capable of integrating with building DDC system.

2.13 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D1654, and ASTM D3359. Submit evidence of satisfactory paint performance for a minimum of 500 hours for units to be installed indoors and 6,000 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D520 Type I.

Field paint factory painting that has been damaged prior to acceptance by the Contracting Officer in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

2.14 SUPPLEMENTAL COMPONENTS/SERVICES

2.14.1 Refrigerant Piping

The requirements for refrigerant piping are specified in Section 23 81 29 VARIABLE REFRIGERANT FLOW HVAC SYSTEMS.

2.14.2 Water Heating System Accessories

The requirements for water or steam heating accessories such as expansion tanks and steam traps are specified in Section 23 21 13.00 20 LOW TEMPERATURE WATER (LTW) HEATING SYSTEM.

2.14.3 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE except as modified herein.

2.14.4 Backflow Preventers

The requirements for backflow preventers are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.14.5 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.14.6 Controls

The requirements for controls are specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS and Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

- a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.
- b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices) and an additional 3 feet.
- c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 6 inch concrete pads or curbs doweled in place unless otherwise

indicated. Make concrete foundations heavy enough to minimize the intensity of the vibrations transmitted to the piping, duct work and the surrounding structure, as recommended in writing by the equipment manufacturer. In lieu of a concrete pad foundation, build a concrete pedestal block with isolators placed between the pedestal block and the floor. Make the concrete foundation or concrete pedestal block a mass not less than three times the weight of the components to be supported. Provide the lines connected to the pump mounted on pedestal blocks with flexible connectors. Submit foundation drawings as specified in paragraph DETAIL DRAWINGS. Provide concrete for foundations as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 08 31 00 ACCESS DOORS AND PANELS.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.2.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.6 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

3.2.7 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate outdoor air intake ducts and plenums up to the point where the outdoor air reaches the conditioning unit.

3.2.8 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

3.2.9 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.3 EQUIPMENT PADS

Provide equipment pads to the dimensions shown or, if not shown, to conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports. Allow equipment bases and foundations, when constructed of concrete or grout, to cure a minimum of 28 calendar days before being loaded.

3.4 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

3.5 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, laboratory or warehouse protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.6 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C553, Type 1, Class B-2.

3.6.1 Sleeves

Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A53/A53M, Schedule 20.

3.6.2 Framed Prepared Openings

Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.

3.6.3 Insulation

Provide duct insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS continuous through sleeves and prepared openings except firewall penetrations. Terminate duct insulation at fire dampers and flexible connections. For duct handling air at or below 60 degrees F, provide insulation continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air.

3.6.4 Closure Collars

Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over 15 inches from 18 gauge galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge galvanized steel. Install collars with fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

3.6.5 Firestopping

Where ducts pass through fire-rated walls, fire partitions, and fire rated chase walls, seal the penetration with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING.

3.7 FIELD PAINTING OF MECHANICAL EQUIPMENT

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except clean to bare metal on metal surfaces subject to temperatures in excess of 120 degrees F. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Provide aluminum or light gray finish coat.

3.7.1 Temperatures less than 120 degrees F

Immediately after cleaning, apply one coat of pretreatment primer applied

to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat to metal surfaces subject to temperatures less than 120 degrees F.

3.7.2 Temperatures between 120 and 400 degrees F

Apply two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of two mils to metal surfaces subject to temperatures between 120 and 400 degrees F.

3.7.3 Temperatures greater than 400 degrees F

Apply two coats of 315 degrees C 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of two mils to metal surfaces subject to temperatures greater than 400 degrees F.

3.7.4 Color Coding Scheme for Locating Hidden Utility Components

Use scheme in buildings having suspended grid ceilings. Provide color coding scheme that identifies points of access for maintenance and operation of components and equipment that are not visible from the finished space and are accessible from the ceiling grid, consisting of a color code board and colored metal disks. Make each colored metal disk approximately 3/8 inch diameter and secure to removable ceiling panels with fasteners. Insert each fastener into the ceiling panel so as to be concealed from view. Provide fasteners that are manually removable without the use of tools and that do not separate from the ceiling panels when the panels are dropped from ceiling height. Make installation of colored metal disks follow completion of the finished surface on which the disks are to be fastened. Provide color code board that is approximately 3 foot wide, 30 inches high, and 1/2 inches thick. Make the board of wood fiberboard and frame under glass or 1/16 inch transparent plastic cover. Make the color code symbols approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. Mount the color code board in the mechanical or equipment room.

3.8 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.9 DAMPER ACCEPTANCE TEST

Submit the proposed schedule, at least 2 weeks prior to the start of test. Operate all fire dampers and smoke dampers under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Test each fire damper equipped with fusible link by having the fusible link cut in place. Test dynamic fire dampers with the air handling and distribution system running. Reset all fire dampers with the fusible links replaced after acceptance testing. To ensure optimum operation and performance, install the damper so it is square and free from racking.

3.10 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.11 PERFORMANCE TESTS

Conduct performance tests as required in Section 23 05 93 Testing, Adjusting and Balancing for HVAC and Section 23 09 00 Instrumentation and Control for HVAC.

3.12 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Inside of air terminal units, thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and provide new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Perform and document that proper "Indoor Air Quality During Construction" procedures have been followed; provide documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.13 OPERATION AND MAINTENANCE

3.13.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data

3.13.2 Operation And Maintenance Training

Conduct a training course for the members of the operating staff as designated by the Contracting Officer. Make the training period consist of a total of 24 hours of normal working time and start it after all work specified herein is functionally completed and the Performance Tests have been approved. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed On-site Training schedule concurrently with the Operation and Maintenance Manuals and at least 14 days prior to conducting the training course.

-- End of Section --

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SECTION 23 52 43.00 20

LOW PRESSURE WATER HEATING BOILERS (UNDER 800,000 BTU/HR OUTPUT)

05/15, CHG 2: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.13/CSA 4.9 (2017; Errata 2018) Gas-Fired Low Pressure
Steam and Hot Water Boilers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPVC SEC IV (2017) BPVC Section IV-Rules for
Construction of Heating Boilers

ASME CSD-1 (2016) Control and Safety Devices for
Automatically Fired Boilers

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M (2020) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS (NBBI)

NBBI NB-23 PART 1 (2013) National Board Inspection Code -
Part 1 Installation

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31 (2020) Standard for the Installation of
Oil-Burning Equipment

NFPA 54 (2021) National Fuel Gas Code

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 795 (2016; Reprint Sep 2020) UL Standard for
Safety Commercial-Industrial Gas Heating
Equipment

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-430-07

(2019) Inspection and Certification of
Boilers and Unfired Pressure Vessels

1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

1.3 DESIGN REQUIREMENTS

Boiler must be suitable for installation in the space shown with ample room for opening doors and cleaning and removal and replacement of tubes. Boiler must be designed and tested in accordance with ASME BPVC SEC IV, ASME CSD-1, NFPA 54, NFPA 31, NFPA 70 and ANSI Z21.13/CSA 4.9. Boiler must be installed in accordance with NBBI NB-23 PART 1. Paint boiler in accordance with manufacturer's recommendations. Boiler design working pressure must be 160 psig.

1.3.1 Boiler Installation Requirements

1.3.1.1 Location

Install Boiler(s) and associated hot water pumps in a mechanical room inside the facility in accordance with NBBI NB-23 PART 1. Provide ample clearance around boilers to allow access for inspection, maintenance and repair. Passageways around all sides of boilers must have an unobstructed minimum width of 36 inches or the clearances recommended by the boiler manufacturer whichever is greater.

1.3.1.2 Combustion Air

Provide directly vented air intake and combustion ductwork. Provide metallic air intake ductwork in accordance with Section 23 30 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS with boiler manufacturer's written instructions. Insulate air intake ductwork in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Provide Boiler Flue Vent in accordance with Section 23 30 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS and boiler manufacturer's written instructions.

1.3.2 Detail Drawings

1.3.2.1 Drawings

Show boiler hot water isolation valves, emergency disconnect switch, and complete boiler gas train on the contract drawings.

1.3.2.2 Fuel Train / Wiring Diagram

Submit fuel train and wiring diagram.

1.3.3 Water Analysis

Provide test reports of water analysis. UFC 3-240-13FN Industrial Water Treatment must be followed for all boiler installations.

1.4 SAFETY STANDARDS

Hot water boilers, burners and supplementary control devices, safety interlocks, or limit controls required under this specification, must meet requirements of the following standards as applicable:

- a. Gas-Fired Units: ASME CSD-1, ASME BPVC SEC IV, NFPA 54, NFPA 70, ANSI Z21.13/CSA 4.9 or UL 795.

Controls not covered by the above must have a UL label, UL listing mark, or must be listed in the Factory Mutual Approval Guide.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fuel Train

Wiring Diagram

SD-03 Product Data

Boilers

Boiler Trim and Control Equipment; G

Burners and Control Equipment; G

Energy Efficient Equipment For Boilers; S

Feedwater Treatment Feeder; G

SD-06 Test Reports

Operational Tests; G

Water Analysis

SD-07 Certificates

Boilers; G

Burners and Control Equipment

Boiler Trim and Control Equipment

SD-08 Manufacturer's Instructions

Boilers

SD-10 Operation and Maintenance Data

Boilers, Data Package 4

Submit in accordance with Section 01 78 23 OPERATION AND
MAINTENANCE DATA.

SD-11 Closeout Submittals

Posted Operating Instructions for Heating Water Boilers

1.6 WARRANTY

Warranties for mechanical systems shall commence following government acceptance of functional performance testing.

PART 2 PRODUCTS

2.1 PRODUCT SUSTAINABILITY CRITERIA

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following:

2.1.1 Energy Efficient Equipment for Boilers

Provide boilers meeting the efficiency requirements as stated within this section and provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph ENERGY EFFICIENT EQUIPMENT.

2.2 BOILERS

Shall conform to the applicable requirements of ASME BPVC SEC IV and ASME CSD-1. Boiler shall be natural gas fired, fully condensing, and fire tube design. The boiler shall be factory-fabricated, factory-assembled, and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Provide each boiler complete with burner and fuel system, a forced or induced draft fan, an automatic electronic control system complete with combustion and flame safeguard controls, firing sequence programmer, safety interlocks, limit controls and central control panel, and such trim and appurtenances as are peculiar to water units as specified herein. Units shall be factory-wired and assembled except for such readily installed appurtenances as safety valves, water columns, and pressure gages. Units shall be complete and ready for operation when connected to water, fuel, and electrical supplies. The heater exchanger shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The heat exchanger shall be constructed of a fully welded 316L stainless steel or cast aluminum and of fire tube design. The heat exchanger shall be designed for a single or multi-pass water flow, but must meet the scheduled water side pressure drop. There shall be no banding material, bolts, gaskets or "O" rings in the heat exchanger design. The condensate collection basin shall be fully welded 316L stainless steel. Boiler shall include an intake air filter with a factory installed air pressure switch. The pressure switch will alert the end user on the screen of the boiler that the intake filter is dirty and needs to be changed. The pressure vessel shall be in accordance with ASME Section IV pressure vessel code.

2.3 BURNERS AND CONTROL EQUIPMENT

2.3.1 Gas-Fired Power Burner

Spark ignition with 100 percent main-valve shutoff with electronic flame supervision. Forced draft single burner premix design. The burner shall be capable of a minimum 10:1 gas turndown without loss of combustion efficiency. Boiler shall be equipped with a modulating blower system to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The burner firing sequence of operation shall include pre-purge, firing, modulation, and post-purge operation. Burner controls and safety equipment shall conform to the applicable requirements of ASME CSD-1, NFPA 54, ANSI Z21.13/CSA 4.9 and UL 795. Mount controls; including operating switches, indicating lights, gages, alarms, motor starters, fuses, and circuit elements of control systems on a single control panel or cabinet designed for separate mounting not on the burner.

2.4 BOILER TRIM AND CONTROL EQUIPMENT

Boiler trim shall comply with ASME BPVC SEC IV and additional appurtenances specified below. Non-recycling control interlocks shall have the reset located on control interlock. Provide in accordance with ASME CSD-1 and ASME BPVC SEC IV.

2.4.1 Emergency Disconnect Switch

Provide and locate on wall outside boiler room entrance or just inside door, when boiler room door is on building exterior as required by ASME CSD-1 to allow rapid and complete shutdown of the boiler in the event of an emergency. Emergency switch must be a fuse-type safety switch. Switch must be red and furnished with a label indicating function of switch.

2.4.2 Relief Valves

Provide relieving capacity for the full output of boiler installed. Safety relief-valve piping must conform to ASTM A53/A53M, schedule 40 steel pipe and be piped full-size to a floor drain.

2.4.3 Condensate Neutralization Kit

Factory-supplied condensate trap with condensate trip sensor, high capacity condensate receiver pre-filled with appropriate medium.

2.4.4 Primary Boiler Pump

Provide boiler with primary boiler pump as indicated on drawings and in accordance with Section 23 21 13.00 20 LOW TEMPERATURE WATER (LTW) HEATING SYSTEM.

2.4.5 Pressure Gage

Provide with a scale equivalent to 1.5 time outlet water pressure with a 6 inch diameter. Locate one on supply water piping and one on the return water piping. Provide in accordance with Section 23 21 13.00 20 LOW TEMPERATURE WATER (LTW) HEATING SYSTEM.

2.4.6 Thermometer

Provide thermometer with a scale equivalent to 1.5 times outlet water temperature. Provide one located on supply water piping and one on return water piping. Provide in accordance with Section 23 21 13.00 20 LOW TEMPERATURE WATER (LTW) HEATING SYSTEM.

2.4.7 Drain Tapping

Provide drain valve and piping to a floor drain.

2.4.8 Make-up Water Station

2.4.8.1 Pressure Reducing Station

Provide a water pressure-reducing valve and relief valve, or a combination of the two in the makeup water line to the boiler to maintain a water pressure of as indicated on the drawings of the hot water system. Provide a 3/4 inch globe valve by-pass around this valve.

2.4.8.2 Backflow Preventers

Section 22 00 00 PLUMBING, GENERAL PURPOSE. Locate upstream of by-pass.

2.4.9 Feedwater Treatment Feeder

See section 23 25 00 CHEMICAL TREATMENT OF WATER FOR MECHANICAL SYSTEMS for chemical shot feeder requirements.

2.4.10 Combustion Regulator

Provide adjustable temperature, thermostatic immersion type that must limit boiler water temperature to a maximum of 250 degrees F. Control must actuate burner through an electric relay system to maintain boiler water temperature within normal prescribed limits at loads within rated capacity of boiler.

2.4.11 Air Vent Valve

Provide with screwed connection, stainless steel disk, and stainless steel seats to vent entrapped air.

2.4.12 High Temperature Limit Switch

Provide adjustable immersible aquastat type with a temperature setting above that of the combustion regulator and below that of the lowest relief valve setting. Aquastat must function to cause a safety shutdown by closing fuel valves, and shutting down burner equipment, activating a red indicating light, and sounding an alarm in the event that boiler water temperature rises to the high temperature limit setting. A safety shutdown due to high temperature must require manual reset before operation can resume and prevent recycling of burner equipment. Pre-set high temperature limit devices that cannot be easily tested are not allowed.

2.4.13 Low Water Level Cutoff Switch

Low water level cutoff must cause a safety shutdown by closing fuel valves, and shutting down burner equipment, activating a red indicating light,

and sounding an alarm in the event that water level drops below the lowest safe permissible water level established by the boiler manufacturer and ASME BPVC SEC IV. A safety shutdown due to low water must require manual reset before operation can resume and prevent recycling of burner equipment.

2.4.14 Boiler Safety Control Circuits

Provide boiler safety control circuits, including control circuits for burner and draft fan, must be single-phase, two-wire one-side grounded, and not over 120 volts. Provide safety control switching in ungrounded conductors. Provide overcurrent protection. In addition to circuit grounds, ground metal parts which do not carry current to a grounding conductor.

2.4.15 Indicating Lights

Each safety interlock requiring a manual reset must have an individually labeled red indicating light. Non-recycling control interlocks must have the reset located on the control itself. Red indicating lights on the control panel may be omitted if the burner combustion control system has a Keyboard Display Module installed that will identify the lockout information required in Item c. below. Indicating lights must have colors as follows:

- a. Amber: Ignition on
- b. Green: Main fuel safety shut-off valves open
- c. Red (One for Each): Safety lockout, flame failure, low water level, and high temperature
- d. Blue: Draft

2.4.16 Boiler Control Panel

Boiler controls shall feature a standard, factory-installed LCD screen display with the following standard features:

- a. Password Security: Boiler shall have a different password security code for the User and the Installer to access adjustable parameters.
- b. Indicating Lights: LCD screen shall display all indicating lights.
- c. Service reminder: Boiler shall have the ability to display a yellow colored service notification screen based upon months of installation, hours of operation, and number of boiler cycles. All notifications are adjustable by the installer.
- d. Anti-cycling control: Boiler shall have the ability to set a time delay after a heating demand is satisfied allowing the boiler to block a new call for heat. The boiler will display an anti-cycling blocking on the screen until the time has elapsed or the water temperature drops below the anti-cycling differential parameter. The anti-cycling control parameter is adjustable by the installer.
- e. Primary pump control: Boiler shall have the ability to control the primary pump to maintain boiler required flow.

- f. BMS integration with 0-10 volts dc input: The Control shall allow an option to Enable and control set point temperature or control firing rate by sending the boiler a 0-10 volts input signal.
- g. Data logging: Boiler shall have non-volatile data logging memory including last 10 lockouts, hours running and ignition attempts and should be able to view on boiler screen.
- h. Cascade Controller: The boiler shall have a built in Cascade controller to sequence and rotate lead boiler to ensure equal runtime while maintaining modulation of all boilers without utilization of an external controller. The factory installed, internal cascade controller shall include:
 - (1) Lead lag.
 - (2) Efficiency optimization: The Control module shall allow multiple boilers to fire at minimum firing rate in lieu of Lead/Lag.
 - (3) Front end loading.
 - (4) Rotation of lead boiler: The Control module shall change the lead boiler every hour for the first 24 hours after initializing the Cascade. Following that, the leader will be changed once every 24 hours.
- i. Building Automation System Interface: Factory installed BACnet gateway interface to enable building automation system to monitor, control, and display boiler status and alarms.

2.4.17 Alarm Bell

Provide alarm bell, electrically operated, with a manual disconnect switch. Disconnect switch must be type and wired so that switching off alarm following a safety shutdown will not prevent alarm from sounding again upon recurrence of a subsequent safety shutdown condition.

2.4.18 Post-Combustion Purge

Provide controls and wiring necessary to ensure operation of draft fan for a period of not less than 15 seconds or of sufficient duration to provide four complete air changes in the boiler combustion chamber (whichever is greater) following shutdown of burner upon satisfaction of heat demand and in accordance with ASME CSD-1. Upon completion of post-combustion purge period, draft fan must automatically shutdown until next restart.

2.4.19 Draft

Intake ductwork in accordance with Section 23 30 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS and boiler manufacturer's written instructions. Insulate air intake ductwork in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

Boiler Flue, Combustion Intake Supports

Provide in accordance with Section 23 30 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS.

2.5 ELECTRIC MOTORS

Electric motors must meet requirements of NEMA MG 1. Motors less than 1 hp must meet NEMA High Efficiency requirements. Motors 1 hp and larger must meet NEMA Premium Efficiency requirements. Motors which are an integral part of the packaged boiler system must be the highest efficiency available by the manufacturer of the packaged boiler. Motors must be variable speed.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Install equipment in accordance with manufacturer's installation instructions and NBBI NB-23 PART 1. Grout equipment mounted on concrete foundations before installing piping. Install piping in such a manner as not to place a strain on equipment. Do not bolt flanged joints tight unless they match. Grade, anchor, guide, and support piping without low pockets. Feedwater treatment feeders must be mounted so that the top of the feeder is no higher than 48 inches above the finished floor.

3.2 EQUIPMENT FOUNDATIONS

Locate equipment foundations as indicated, designed, and made of sufficient size and weight to preclude shifting of equipment under operating conditions or under abnormal conditions that could be imposed upon the equipment. Foundations must meet requirements of the equipment manufacturer. Concrete and grout must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.3 MANUFACTURER'S FIELD SERVICES

Furnish the services of an engineer or technician approved by the boiler manufacturer for installation inspection, startup, and tests of equipment as specified below. After installation of equipment the engineer or technician shall provide a signed certificate or certified written statement that the equipment is installed in accordance with the manufacturer's recommendations. Services of more than one engineer or technician may be required based on types of specific equipment. One engineer or technician as appointed by the Contractor shall supervise and be responsible for the overall installation, start-up, test, and check-out of systems. This person shall remain on the job until each unit has been in successful operation for 3 days and accepted.

3.4 BOILER CLEANING

Before being placed in service, flush out boiler with potable water, drain, and charge with chemically treated water. Protect boiler and appurtenances against internal corrosion until testing is completed and boiler is accepted. Professional services are required for cleaning/treatment process.

3.5 FIELD QUALITY CONTROL

Perform and furnish everything required for inspections and tests as specified herein to demonstrate that boiler and auxiliary equipment, as installed, are in compliance with contract requirements. Start-up and operate the system. During this time, clean strainers until no further accumulation of foreign material occurs. Exercise care to minimize loss

of water when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence. Test instrumentation must be calibrated and have full scale readings from 1.5 to 2 times test values.

3.5.1 Operational Tests

Furnish the services of an engineer or technician approved by the boiler manufacturer of installation, startup, operational and safety testing. This person must remain on the job until each boiler has been successfully operated. Furnish and perform everything required for inspections and tests of the boiler and auxiliary equipment. Test instrumentation must be calibrated and have full-scale reading from 1.5 to 2 times test values. Demonstrate proper operability of combustion control, flame safeguard control and safety interlocks. Provide a detailed description of all boiler startup and operational tests in the Commissioning Plan.

3.5.1.1 Preliminary Operational Test

Operate the boilers continuously for a period of at least 8 hours to demonstrate proper operability of the combustion control, flame safeguard control, and safety interlocks.

3.5.1.2 Acceptance Operational Test and Inspection

Prior to requesting an acceptance test, conduct a satisfactory operational test for at least 8 hours, and provide a certified statement that the equipment is installed per all requirements of this guide. Contracting Officer, upon receipt of the notice from the Contractor, will request a boiler inspection by a Naval Facilities Engineering and Expeditionary Warfare Center (EXWC) NAVFAC boiler inspector. Fifteen days advance notice is required for scheduling inspector to conduct acceptance operational test and inspection. All boilers and pressure vessels require certifications in accordance to UFC 3-430-07 prior to turning over to the Government. Request in writing that the government start the certification and acceptance testing procedure 120 days prior to the anticipated turnover date. The government boiler inspector shall be present and witness the startup of boiler systems. The Contractor is responsible for coordinating with the Boiler Inspector.

-- End of Section --

SECTION 23 81 00

DECENTRALIZED UNITARY HVAC EQUIPMENT
05/18, CHG 1: 02/21

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section with the additions and modifications specified herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 500-D (2018) Laboratory Methods of Testing
Dampers for Rating

AMCA 500-L (2015) Laboratory Methods of Testing
Louvers for Rating

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 700 (2016) Specifications for Fluorocarbon
Refrigerants

ANSI/AHRI 210/240 (2008; Add 1 2011; Add 2 2012) Performance
Rating of Unitary Air-Conditioning &
Air-Source Heat Pump Equipment

ANSI/AHRI 340/360 (2007; Addendum 1 2010; Addendum 2 2011)
Performance Rating of Commercial and
Industrial Unitary Air-Conditioning and
Heat Pump Equipment

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ANSI/ASHRAE 15 & 34 (2013) ANSI/ASHRAE Standard 15-Safety
Standard for Refrigeration Systems and
ANSI/ASHRAE Standard 34-Designation and
Safety Classification of Refrigerants

ASHRAE 15 & 34 (2013) ASHRAE Standard 34-2016 Safety
Standard for Refrigeration Systems/ASHRAE
Standard 34-2016 Designation and Safety
Classification of Refrigerants-ASHRAE
Standard 34-2016

ASHRAE 52.2 (2012) Method of Testing General

Ventilation Air-Cleaning Devices for
Removal Efficiency by Particle Size

ASHRAE 62.1 (2010) Ventilation for Acceptable Indoor
Air Quality

ASHRAE 90.1 - IP (2013) Energy Standard for Buildings
Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.5 (2020) Refrigeration Piping and Heat
Transfer Components

ASME BPVC SEC IX (2017; Errata 2018) BPVC Section
IX-Welding, Brazing and Fusing
Qualifications

ASME BPVC SEC VIII D1 (2019) BPVC Section VIII-Rules for
Construction of Pressure Vessels Division 1

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2019) Specification for Filler Metals for
Brazing and Braze Welding

AWS Z49.1 (2012) Safety in Welding and Cutting and
Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM A307 (2021) Standard Specification for Carbon
Steel Bolts, Studs, and Threaded Rod 60
000 PSI Tensile Strength

ASTM B117 (2019) Standard Practice for Operating
Salt Spray (Fog) Apparatus

ASTM C1071 (2019) Standard Specification for Fibrous
Glass Duct Lining Insulation (Thermal and
Sound Absorbing Material)

ASTM D520 (2000; R 2011) Zinc Dust Pigment

ASTM E84 (2020) Standard Test Method for Surface
Burning Characteristics of Building
Materials

ASTM F104 (2011; R 2020) Standard Classification
System for Nonmetallic Gasket Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-58 (2018) Pipe Hangers and Supports -
Materials, Design and Manufacture,
Selection, Application, and Installation

MSS SP-69 (2003; Notice 2012) Pipe Hangers and

Supports - Selection and Application (ANSI
Approved American National Standard)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators
NEMA MG 2 (2014) Safety Standard for Construction
and Guide for Selection, Installation and
Use of Electric Motors and Generators

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50502 (Basic) Air Conditioners, (Unitary Heat
Pump), Air to Air (3,000 to 300,000 BTU)

U.S. DEPARTMENT OF DEFENSE (DOD)

UNDERWRITERS LABORATORIES (UL)

UL 1995 (2015) UL Standard for Safety Heating and
Cooling Equipment

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mini-Split-System Heat Pumps; G
Coil Corrosion Protection
Manufacturer's Standard Catalog Data
Self-Contained Air Conditioner; G

SD-06 Test Reports

Refrigerant Tests, Charging, and Start-Up; G

SD-07 Certificates

Service Organizations

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

SD-11 Closeout Submittals

Ozone Depleting Substances; S

1.4 QUALITY ASSURANCE

Carefully investigate the plumbing, fire protection, electrical,

structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Submit drawings consisting of:

- a. Equipment layouts which identify assembly and installation details.
- b. Plans and elevations which identify clearances required for maintenance and operation.
- c. Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.
- d. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.
- e. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.
- f. Automatic temperature control diagrams and control sequences.
- g. Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.
- h. Equipment schedules

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Properly protect and care for all material both before and during installation. Replace any materials found to be damaged, at no additional cost to the Government. During installation, cap piping and similar openings capped to keep out dirt and other foreign matter.

1.6 ENVIRONMENTAL REQUIREMENTS

For proper Indoor Environmental Quality, maintain pressure within the building as indicated. Ventilation must meet or exceed ASHRAE 62.1 and all published addenda. Meet or exceed filter media efficiency as tested in accordance with ASHRAE 52.2.

1.7 WARRANTY

Provide equipment with the Manufacturer's Standard Warranty.

PART 2 PRODUCTS

2.1 ENERGY EFFICIENCY REQUIREMENTS

42 USC 8259b requires the procurement of energy efficient products in product categories covered by the Energy Star program or the Federal Energy Management Program for designated products. A list of covered product categories is available from the Federal Energy Management Web site at <http://energy.gov/eere/femp/covered-product-categories>. A list of qualified light commercial products is available at <http://www.energystar.gov/productfinder/product/certified-light-commercial-hvac/result>

For product categories covered by the Energy Star program, submit documentation that the product is Energy Star-qualified. For product categories covered by the Federal Energy Management Program, submit documentation that the product meets or exceeds FEMP-designated efficiency requirements.

2.1.1 Air-Source Heat Pumps

Selected air-source heat pumps are required to meet applicable performance requirements specified by Energy Star. Information on the requirements can be found for residential models (single-phase units of 65,000 BTU/h or less) at

http://www.energystar.gov/products/specs/system/files/Central_ASHP_and_CAC_Program_Req_v4_1.pdf and for light commercial models (three-phase units of less than 240,000 BTU/h) at

http://www.energystar.gov/products/specs/system/files/lchvac_prog_req_v2_2_0.pdf.

2.2 MATERIALS

Provide Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data includes manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit data for each specified component. Minimum efficiency requirements must be in accordance with ASHRAE 90.1 - IP.

2.2.1 Standard Products

Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use includes applications of equipment and materials under similar circumstances and of similar size. The 2 years' experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products must be supported by a service organization. Ensure system components are environmentally suitable for the indicated geographic locations.

2.2.2 Product Sustainability Criteria

2.2.2.1 Energy Efficient Equipment

Provide equipment meeting the efficiency requirements as stated within this section and provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph ENERGY EFFICIENT EQUIPMENT.

2.2.2.2 Electrical Equipment / Motors

Provide electrical equipment, motors, motor efficiencies, and wiring which are in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical motor driven equipment specified must be provided complete with motors, motor starters, and controls. Electrical characteristics must be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, must be the premium efficiency type in accordance with NEMA MG 1. Field wiring must be in accordance with manufacturer's instructions. Each motor must conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors must be continuous duty with the enclosure specified. Motor starters must be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors must be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors must be sized for the applicable loads. Motor torque must be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings must be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, must be provided.

2.2.2.3 Ozone Depleting Substances

Unitary air conditioning equipment must not use CFC-based refrigerants. Refrigerant may be an approved alternative refrigerant in accordance with EPA's Significant New Alternative Policy (SNAP) listing. Provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph OZONE DEPLETING SUBSTANCES.

2.2.3 Nameplates

Major equipment including compressors, condensers, receivers, heat exchanges, fans, and motors must have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates must be durable and legible throughout equipment life and made of anodized aluminum. Fix plates in prominent locations with nonferrous screws or bolts.

2.2.4 Safety Devices

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.

2.3 EQUIPMENT

2.3.1 Self-Contained Air Conditioner (RTU-1)

2.3.1.1 Large-Capacity Self-Contained air conditioners (Greater than 65,000 Btu/h)

2.3.1.1.1 General

Provide an air-cooled, factory assembled, weatherproof packaged unit for dedicated downflow airflow. Exterior panels must be zinc coated galvanized steel phosphatized and painted. All access doors and panels must be hinged with neoprene gaskets. Unit must be listed, labeled, and classified in accordance with UL 1995. Unit must be rated in accordance with ANSI/AHRI 340/360. Evaporator fans must be direct drive forward curved centrifugal scroll type. Condenser fans must be manufacturer's standard for the unit specified and may be either propeller or centrifugal scroll type. Provide unit with a full factory operating charge of refrigerant. Unit must be 100 percent run tested at the factory. No penetrations are allowed within the perimeter of the curb in the down flow unit's base pan other than the raised 1-1/8 inch high supply/return openings to provide added water integrity precaution from condensate drain back up.

Provide direct drive plenum supply fan(s). Thermally protect all motors. Provide unit with a removable, reversible, double-sloped condensate drain pan. Provide unit with hot gas reheat.

2.3.1.1.2 Casing

Construct exterior casings for the specified unitary equipment of factory phosphatized and painted galvanized steel or aluminum sheet metal and galvanized or aluminum structural members. Fit casing with lifting provisions, access panels or doors, fan vibration isolators, electrical control panel, corrosion-resistant components, structural support members, insulated condensate drip pan and drain, and internal insulation in the cold section of the casing. All access doors and panels must have neoprene gaskets. Casing must have double-wall, hinged access doors for filters, heating, return/exhaust air, and supply fan section. Incorporate provisions to permit replacement of major unit components. Seal penetrations of cabinet surfaces, including the floor. Unit base must be watertight. Fit unit with a drain pan which extends under all areas where water may accumulate. Fabricate drain pan from Type 316 stainless steel. Pan insulation must be water impervious. Extent and effectiveness of the insulation of unit air containment surfaces must prevent, within limits of the specified insulation, heat transfer between the unit exterior and ambient air, heat transfer between the two conditioned air streams, and condensation on surfaces. Insulation must conform to ASTM C1071.

Coat the entire exterior casing and unit base with a uniformly applied phenolic type coating to all coil surface areas without material bridging between fins. Apply coating at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation. Coating must be capable of withstanding a minimum 6,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.3.1.1.3 Air-to-Refrigerant Coils

Provide air-to-refrigerant coils with seamless copper tubes of 5/16 inch minimum diameter with copper fins that are mechanically bonded or soldered to the tubes. Casing must be galvanized steel or aluminum. Avoid contact of dissimilar metals. Test coils in accordance with ANSI/ASHRAE 15 & 34 at the factory and must be suitable for the working pressure of the installed system. Factory pressure and leak test each coil.

- a. Provide separate expansion devices for each compressor circuit. Condensate drain pans must be removable and double-sloped.
- b. Dual compressor units must have intermingled evaporator coils.
- c. Condensate drain pans must be removable and double-sloped.
- d. Provide condenser coils with hail protection guards.
- e. Coat condenser and evaporator coil with a uniformly applied phenolic type coating to all coil surface areas without material bridging between fins. Apply coating at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation. Coating must be capable of withstanding a minimum 6,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.3.1.1.4 Compressor

Provide direct drive, hermetic reciprocating, type compressor. Compressor must have internal over current and over temperature protection, internal pressure relief, high pressure cutout, rotor lock suction and discharge refrigerant connections, centrifugal oil pump, vibration isolation, and discharge refrigerant connections. Compressors must have crankcase heaters. Motor must be suction gas-cooled. Cooling partial load capacity must be provided by a variable speed compressor.

2.3.1.1.5 Refrigeration Circuit

Refrigerant containing components must comply with ANSI/ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Provide refrigerant lines with service pressure tap ports and refrigerant line filter.

2.3.1.1.6 Unit Controls

Provide units internally prewired by manufacturer with a 24 volt electromechanical control circuit powered by an internal transformer. Provide terminal blocks for power wiring and external control wiring. Internally protect unit by a circuit breaker in accordance with UL 1995. Units with three-phase power must be equipped with phase monitoring protection to protect against problems caused by phase loss, phase imbalance and phase reversal.

- a. Controls must include a control system interface to a BACnet Control system. The control system interface must meet DDC Hardware requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

2.3.1.1.7 Supply Air Fan

Units having AHRI cooling capacity equal or greater than 110,000 Btu/h must have supply fans controlled by variable speed motors. Supply fan motors shall be open drip-proof. All supply fans shall be dynamically balanced in factory. Each motor shall have its own variable frequency drive.

Provide direct drive plenum supply fan(s). Fan blades shall be aluminum airfoil.

2.3.1.1.8 Roof Curb

Provide a roof curb that mates with the unit to provide support and be completely weather tight. Provide curb with sealing strips to ensure an airtight seal between supply and return openings of the curb and unit. Design curb to allow ductwork to be directly connected to the curb. The roof curb must be provided by the Manufacturer of the equipment. The roof curb must be a minimum of 18 inches tall.

2.3.1.1.9 Primary/Supplemental Heat

Provide heating unit with internal thermal insulation having a fire hazard rating not to exceed 25 for flame spread and 50 for smoke developed as determined by ASTM E84.

2.3.1.1.9.1 Hot Water Coils

Serpentine type constructed of seamless copper tubes with aluminum fins mechanically or hydraulically bonded to tubes. Provide factory-furnished tee and manual air vent on return connection. Factory test coils at twice maximum operating pressure.

2.3.1.1.10 Single Source Power Entry

Provide single source power entry to allow single source power connection to unit and heater combination. Single source power entry kit includes specific matching heater(s), high voltage terminal blocks, fuse blocks and fuses, cut-to-length interconnecting wiring, and plug with matching receptacle to provide power sources with fuse protection as required for both the unit and accessory heater. The equipment disconnect must be provided by the Manufacturer of the equipment.

2.3.1.1.11 Fully Modulating Economizer

Provide fully modulating economizer to include 0-100 percent fresh air damper, damper drive motor, and fixed dry bulb enthalpy control. Control economizer operations by the pre-set position of the enthalpy control. Include a barometric relief damper with the down flow economizer to provide a pressure operated damper that is gravity closing and prohibits entrance of outside air on equipment "off" cycle. Economizer dampers must be ultra low-leak type with leakage rate of one percent based on testing data completed in accordance with AMCA 500-D.

2.3.1.1.12 Manual Outside Air Damper

Provide manual outside air damper with rain hood and screen suitable for up to 25 percent outside air. Test Louvers in accordance with AMCA 500-L.

2.3.1.1.13 Low Ambient Control

Provide low ambient control to allow cycling of compressor for cooling operation at low ambient temperatures down to 0 degrees F.

2.3.1.1.14 Filters

Provide 2 inch thick high efficiency throwaway type filters that are MERV 8 and 13. Filters must have an average arrestance of 90 percent when tested in accordance with ASHRAE 52.2. Filters must be UL Class 1.

2.3.2 Mini-Split-System Heat Pumps

2.3.2.1 Small-Capacity Split-System Air-Conditioners (Not Exceeding 65,000 Btu/hr)

Provide an air-cooled, split system which employs a remote condensing unit, a separate wall mounted or horizontal suspended indoor unit as indicated on drawings, and interconnecting refrigerant piping. Provide inverter driven split system heat pump. Provide the heat pump type unit conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit must be rated in accordance with ANSI/AHRI 210/240. Provide indoor unit with necessary fans, air filters, and galvanized steel cabinet construction. The remote unit must be as specified in paragraph CONDENSING UNIT. Provide double-width, double inlet, forward curved backward inclined, or airfoil blade, centrifugal scroll type evaporator or supply fans. Provide the manufacturer's standard condenser or outdoor fans for the unit specified and must be propeller type. Fan and condenser motors must have totally enclosed enclosures. Design unit to operate at outdoor ambient temperatures up to 115 degrees F.

2.3.2.1.1 Energy Efficiency

Provide unit with an Energy Star label.

2.3.2.1.2 Air-to-Refrigerant Coil

Provide condensing coils with copper tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Casing must be galvanized steel or aluminum. Avoid contact of dissimilar metals. Test coils in accordance with ASHRAE 15 & 34 at the factory and ensure suitability for the working pressure of the installed system. Dehydrate and seal each coil testing and prior to evaluation and charging.

Coat condenser and evaporator coil with a uniformly applied phenolic type coating to all coil surface areas without material bridging between fins. Apply coating at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation and be capable of withstanding a minimum 6,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.3.2.1.3 Refrigeration Circuit

Refrigerant-containing components must comply with ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Provide each unit with a factory operating charge of refrigerant and oil or a holding charge. Field charge unit shipped with a holding charge. Provide refrigerant charging valves. Provide filter-drier in liquid line to

prevent freeze-up in event of loss of water flow during heating cycle.

2.3.2.1.4 Unit Controls

Provide unit internally prewired with a 24 volt control circuit powered by an internal transformer. Provide terminal blocks for power wiring and external control wiring. Internally protect unit by fuses or a circuit breaker in accordance with UL 1995. Equip units with three-phase power with phase monitoring protection to protect against problems caused by phase loss, phase imbalance and phase reversal. Provide unit with microprocessor controls to provide all 24V control functions.

Controls must include a control system interface to a BACnet Control system. The control system interface, as well as any network between physically separate units, must meet the requirements of Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

2.3.2.1.5 Air Filters

Provide filters of the cleanable type for wall mounted units that are capable of filtering the entire air supply. Mount filter(s) integral within the unit and make accessible by hinged access panel(s). Provide throwaway MERV 8 filter for suspended horizontal units as indicated on drawings.

2.3.2.1.6 Fans

Provide direct driven, statically and dynamically balanced, centrifugal or propeller type fans. Design the outdoor fan so that condensate will evaporate without drip, splash, or spray on building exterior. Provide indoor fan with a minimum two-speed motor with built-in overload protection. Fan motors must be the inherently protected, permanent split-capacitor type.

2.4 COMPONENTS

2.4.1 Refrigerant and Oil

Refrigerant must be one of the fluorocarbon gases. Refrigerants must have number designations and safety classifications in accordance with ASHRAE 15 & 34. Refrigerants must meet the requirements of AHRI 700 as a minimum. Provide a complete charge of refrigerant for the installed system as recommended by the manufacturer. Lubricating oil must be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge must be in accordance with manufacturer's recommendation.

2.4.2 Fans

Fan wheel shafts must be supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans must be selected to produce the cfm required at the fan total pressure. Motor starters, if applicable, must be magnetic across-the-line type with a totally enclosed enclosure. Thermal overload protection must be of the manual or automatic-reset type. Fan wheels or propellers must be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings must be of galvanized steel, and both centrifugal and propeller fan casings must be constructed of aluminum or

galvanized steel. Steel elements of fans, except fan shafts, must be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting must be recoated with an approved zinc-rich compound. Fan wheels or propellers must be statically and dynamically balanced. Direct-drive fan motors must be of the multiple-speed variety. Each drive will be independent of any other drive. Propeller fans must be direct-drive drive type with fixed pitch blades.

2.5 UNITARY EQUIPMENT ACCESSORIES AND MISCELLANEOUS EQUIPMENT

2.5.1 Air Economizer

Provide horizontal flow factory installed economizer with fully modulating 0-100 percent motor and dampers, automatic relief damper, minimum position setting and fixed dry bulb. Field install solid state enthalpy and differential enthalpy control.

2.5.2 Gaskets

Provide gaskets conforming to ASTM F104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.5.3 Bolts and Nuts

Bolts and nuts must be in accordance with ASTM A307. The bolt head must be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A307.

2.5.4 Bird Screen

Screen must be 0.063 inch diameter aluminum wire or 0.031 inch diameter stainless steel wire.

2.6 FINISHES

2.6.1 Coil Corrosion Protection

Provide coil with a uniformly applied phenolic type coating to all coil surface areas without material bridging between fins. Submit product data on the type coating selected, the coating thickness, the application process used, the estimated heat transfer loss of the coil, and verification of conformance with the salt spray test requirement. Coating must be applied at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation. Coating must be capable of withstanding a minimum 6,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.6.2 Equipment and Components Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, must be factory finished with the manufacturer's standard finish, except that items located outside of buildings must have weather resistant finishes that will withstand 6,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen must show no signs of blistering, wrinkling, cracking, or loss of adhesion and

no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used must be coated with a zinc-rich coating conforming to ASTM D520, Type I.

Where stipulated in equipment specifications of this section, coat finned tube coils of the affected equipment as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating must show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins.

2.6.2.1 Phenolic Coating

Provide a resin base thermosetting phenolic coating. Apply coating by immersion dipping of the entire coil. Provide a minimum of two coats. Bake or heat dry coils following immersions. After final immersion and prior to final baking, spray entire coil with particular emphasis given to building up coating on sheared edges. Total dry film thickness must be 2.5 to 3.0 mils.

2.6.3 Factory Applied Insulation

Refrigeration equipment must be provided with factory installed insulation on surfaces subject to sweating including the suction line piping. Where motors are the gas-cooled type, factory installed insulation must be provided on the cold-gas inlet connection to the motor in accordance with manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors must have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces must have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes must be determined by ASTM E84. Insulation must be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket must be tested as a composite material. Jackets, facings, and adhesives must have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E84.

2.7 TESTS, INSPECTIONS, AND VERIFICATIONS

All manufactured units must be inspected and tested, and documentation provided to demonstrate that each unit is in compliance with ANSI/AHRI and UL requirements and that the minimum efficiency requirements of ASHRAE 90.1 - IP have been met.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform Verification of Dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION

Perform work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPVC SEC VIII D1 and ASME BPVC SEC IX, the design, fabrication, and installation of the system must conform to ASME BPVC SEC VIII D1 and ASME BPVC SEC IX.

3.2.1 Equipment

Provide refrigeration equipment conforming to ASHRAE 15 & 34. Provide necessary supports for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, and similar items. Isolate compressors from the building structure. If mechanical vibration isolators are not provided, provide vibration absorbing foundations. Each foundation must include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment must be set on not less than a 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps must have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block must be of mass not less than three times the combined pump, motor, and base weights. Isolators must be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators must limit vibration to 10 percent at lowest equipment rpm. Provide lines connected to pumps mounted on pedestal blocks with flexible connectors. Provide foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations must be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Equipment must be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.2.2 Field Applied Insulation

Apply field applied insulation as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.2.3 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09 90 00 PAINTS AND COATINGS.

3.3 CLEANING AND ADJUSTING

Equipment must be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters must be provided for all fans that are operated during construction, and new filters must be installed after all construction dirt has been removed from the building. System must be maintained in this clean condition until final acceptance. Bearings must be properly lubricated with oil or grease as recommended by the manufacturer. Belts must be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment must be adjusted to setting indicated or directed. Fans must be adjusted to the speed indicated by the manufacturer to meet specified conditions. Testing,

adjusting, and balancing must be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.4 PIPING

Brazing, bending, forming and assembly of refrigerant piping shall conform to ASME B31.5.

3.4.1 Pipe Hangers and Supports

Design and fabrication of pipe hangers, supports, and welding attachments shall conform to MSS SP-58. Installation of hanger types and supports for bare and covered pipes shall conform to MSS SP-69 for the system temperature range. Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP-58.

3.4.2 Refrigerant Piping

Cut pipe to measurements established at the site and work into place without springing or forcing. Install piping with sufficient flexibility to provide for expansion and contraction due to temperature fluctuation. Where pipe passes through building structure pipe joints shall not be concealed, but shall be located where they may be readily inspected. Install piping to be insulated with sufficient clearance to permit application of insulation. Install piping as indicated and detailed, to avoid interference with other piping, conduit, or equipment. Except where specifically indicated otherwise, run piping plumb and straight and parallel to walls and ceilings. Trapping of lines will not be permitted except where indicated. Provide sleeves of suitable size for lines passing through building structure. Braze refrigerant piping with silver solder complying with AWS A5.8/A5.8M. Inside of tubing and fittings shall be free of flux. Clean parts to be jointed with emery cloth and keep hot until solder has penetrated full depth of fitting and extra flux has been expelled. Cool joints in air and remove flame marks and traces of flux. During brazing operation, prevent oxide film from forming on inside of tubing by slowly flowing dry nitrogen through tubing to expel air. Make provisions to automatically return oil on halocarbon systems. Installation of piping shall comply with ASME B31.5.

3.4.3 Returning Oil From Refrigerant System

Install refrigerant lines so that gas velocity in the evaporator suction line is sufficient to move oil along with gas to the compressor. Where equipment location requires vertical risers, line shall be sized to maintain sufficient velocity to lift oil at minimum system loading and corresponding reduction of gas volume. Install a double riser when excess velocity and pressure drop would result from full system loading. Larger riser shall have a trap, of minimum volume, obtained by use of 90- and 45-degree ells. Arrange small riser with inlet close to bottom of horizontal line, and connect to top of upper horizontal line. Do not install valves in risers.

3.4.4 Refrigerant Driers, Sight Glass Indicators, and Strainers

Provide refrigerant driers, sight glass liquid indicators, and strainers in refrigerant piping in accordance with CID A-A-50502 and this section when not furnished by the manufacturer as part of the equipment. Install driers in liquid line with service valves and valved bypass line the same size as liquid line in which dryer is installed. Size of driers shall be

determined by piping and installation of the unit on location. Install dryers of 50 cubic inches and larger vertically with the cover for removing cartridge at the bottom. Install moisture indicators in the liquid line downstream of the drier. Indicator connections shall be the same size as the liquid line in which it is installed.

3.4.5 Strainer Locations and Installation

Locate strainers close to equipment they are to protect. Provide a strainer in common refrigerant liquid supply to two or more thermal valves in parallel when each thermal valve has a built-in strainer. Install strainers with screen down and in direction of flow as indicated on strainer's body.

3.4.6 Solenoid Valve Installation

Install solenoid valves in horizontal lines with stem vertical and with flow in direction indicated on valve. If not incorporated as integral part of the valve, provide a strainer upstream of the solenoid valve. Provide service valves upstream of the solenoid valve, upstream of the strainer, and downstream of the solenoid valve. Remove the internal parts of the solenoid valve when brazing the valve.

3.5 FIELD QUALITY CONTROL

3.5.1 Leak Testing

Upon completion of installation of air conditioning equipment, test factory- and field-installed refrigerant piping with an electronic-type leak detector. Use same type of refrigerant to be provided in the system for leak testing. When nitrogen is used to boost system pressure for testing, ensure that it is eliminated from the system before charging. Minimum refrigerant leak field test pressure shall be as specified in ANSI/ASHRAE 15 & 34, except that test pressure shall not exceed 150 psig on hermetic compressors unless otherwise specified as a low side test pressure on the equipment nameplate. If leaks are detected at time of installation or during warranty period, remove the entire refrigerant charge from the system, correct leaks, and retest system.

3.5.2 Evacuation, Dehydration, and Charging

After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field-charged and factory-charged systems, evacuate the system using a reliable gage and a vacuum pump capable of pulling a vacuum of at least one mm Hg absolute. Evacuate system in accordance with the triple-evacuation and blotter method or in accordance with equipment manufacturer's printed instructions and recharge system.

3.6 REFRIGERANT TESTS, CHARGING, AND START-UP

Split-system refrigerant piping systems must be tested and charged as specified in paragraph FIELD QUALITY CONTROL. Packaged refrigerant systems which are factory charged must be checked for refrigerant and oil capacity to verify proper refrigerant levels in accordance with manufacturer's recommendations. Following charging, packaged systems must be tested for leaks with a halide torch or an electronic leak detector. Submit 6 copies of each test containing the information described below in bound 8-1/2 by 11 inch booklets. Individual reports must be submitted for

the refrigerant system tests.

- a. The date the tests were performed.
- b. A list of equipment used, with calibration certifications.
- c. Initial test summaries.
- d. Repairs/adjustments performed.
- e. Final test results.

3.6.1 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system must immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances must the refrigerant be discharged into the atmosphere.

3.6.2 Contractor's Responsibility

Take steps, at all times during the installation and testing of the refrigeration system, to prevent the release of refrigerants into the atmosphere. The steps must include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time must more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year must be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.7 MAINTENANCE

3.7.1 EXTRA MATERIALS

Submit 2 complete copies of an Operation and Maintenance Manuals in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown.

3.7.2 Maintenance Service

Submit a certified list of qualified permanent service organizations, which includes their addresses and qualifications, for support of the equipment. The service organizations must be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

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SECTION 23 81 29

VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

02/20

PART 1 GENERAL

1.1 SUMMARY

Provide a complete Air Source type Variable Refrigerant Flow (VRF) System consisting of one or more outdoor compressor units and multiple indoor fan coil units as specified in this Section and in accordance with the following:

- a. This section only applies to outdoor unit CU-6 & CU-7 and associated indoor units.
- b. Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC applies to the VRF system, and all work under this Section must be in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC including but not limited to the open system, protocol, installation, submittal, testing and training requirements of that Section. Unless the specific VRF system being installed is specifically excepted from the open protocol requirements by Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC, the use of non-CEA-709.1-D Non-ASHRAE 135 networks are prohibited.

The VRF control system must be in accordance with Section 25 05 11.01 CYBERSECURITY FOR BUILDING AUTOMATION SYSTEM.

- c. The complete system must be a tested combination in accordance with AHRI 1230.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 1230	(2010; Addendum 1 2011; Addendum 2 2014) Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment
ANSI/AHRI 270	(2008) Sound Rating of Outdoor Unitary Equipment
ANSI/AHRI 495	(2005) Performance Rating of Refrigerant Liquid Receivers
ANSI/AHRI 760	(2007) Performance Rating of Solenoid Valves for Use With Volatile Refrigerants

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ANSI/ASHRAE 15 & 34	(2013) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants
ASHRAE 15 & 34	(2013) ASHRAE Standard 34-2016 Safety Standard for Refrigeration Systems/ASHRAE Standard 34-2016 Designation and Safety Classification of Refrigerants-ASHRAE Standard 34-2016
ASHRAE 90.1 - IP	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 135	(2016) BACnet-A Data Communication Protocol for Building Automation and Control Networks

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B31.5	(2020) Refrigeration Piping and Heat Transfer Components
ASME BPVC SEC VIII	(2010) Boiler and Pressure Vessel Codes: Section VIII Rules for Construction of Pressure Vessel
ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS Z49.1	(2012) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B280	(2020) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F104	(2011; R 2020) Standard Classification System for Nonmetallic Gasket Materials
CONSUMER ELECTRONICS ASSOCIATION (CEA)	
CEA-709.1-D	(2014) Control Network Protocol Specification
MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)	
MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)	
NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(2018) Motors and Generators
NEMA MG 2	(2014) Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
U.S. DEPARTMENT OF ENERGY (DOE)	
Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
40 CFR 82	Protection of Stratospheric Ozone
UNDERWRITERS LABORATORIES (UL)	
UL 207	(2009; Reprint Jan 2020) Refrigerant-Containing Components and Accessories, Nonelectrical
UL 429	(2013; Reprint Jan 2020) Electrically Operated Valves
UL 586	(2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units
UL 900	(2015) Standard for Air Filter Units
UL 1995	(2015) UL Standard for Safety Heating and Cooling Equipment

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualification Of Installer; G

SD-02 Shop Drawings

VRF System Contractor Design Drawings; G

SD-03 Product Data

Spare Parts Data; G

Coil Corrosion Protection; G

Manufacturer's Standard Catalog Data; G

Sample Warranty; G

Refrigerant SDS Sheets; G

SD-05 Design Data

Manufacturer's Engineering Data; G

SD-06 Test Reports

System Performance Tests; G

SD-07 Certificates

Service Organizations; G

Warranty; G

Ozone Depleting Substances Technician Certification; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions; G

SD-09 Manufacturer's Field Reports

Refrigerant Charging; G

SD-11 Closeout Submittals

Posted Instructions; G

Inventory; G

1.4 QUALITY ASSURANCE

Complete VRF systems must be purchased from a single supplier. The VRF system supplier must be responsible for providing a fully functional VRF system.

1.4.1 VRF System Contractor Design Drawings

Submit VRF System Contractor Design Drawings drawings 5 weeks prior to purchasing the VRF components in a single transmittal. Equipment layouts must be drawn to scale. Shop drawings must be approved by the VRF manufacturers representative. Include approval with name and contact information of VRF manufacturer's representative in the submittal. Place separation sheets before each of the following items covering each item with title and number.

- a. Equipment layouts which identify assembly and installation details. Identify scheduled items with indicating marks. Include manufacturer's selection report for equipment, components and fittings.
- b. Plans and elevations which identify dimensioned clearances required for maintenance and operation. Show access panels with dimensions.
- c. Foundation drawings, bolt-setting information, and foundation bolts.
- d. Details which include loadings and type of frames, brackets, stanchions, guides, anchors or other supports.
- e. Installation details which includes refrigerant type and charge weight for the system (not only the factory-supplied outdoor unit). Indicate factory setpoints for superheat/subcooling, target evaporating/condensing and corresponding refrigerant pressures/temperatures. Also include saturation reset schedule.
- f. Piping layouts must be to scale and piping must have radial and linear dimensions identifying pipe type. Identify each refrigerant circuit and indicate refrigerant type and mass. Indicate piping expansion components and directions of thermal expansion. Piping layouts must be in accordance with ANSI/ASHRAE 15 & 34.
- g. Schedules of equipment, valves, and manufacturer fittings. Mark each item with a common type identifier and unique number.
- h. Calculations for refrigerant mass and pipe expansion.
- i. Sequence of Operations of system and components.
- j. Calculations demonstrating compliance with ANSI/ASHRAE 15 & 34.

1.5 QUALITY CONTROL

1.5.1 Qualifications

1.5.1.1 Qualification Of Installer

Submit 3 copies of qualifications prior to installation. The installers must be trained and qualified to install the same type of VRF system components to be installed under this contract by the same manufacturer. Include training certificates in submittal. The installer must have

performed three complete installations of VRF systems of the same type and manufacturer that resulted in successful commissioning. Include project VRF installation and product information, location, customer contact information and VRF manufacturer representative contact information. The customer and VRF representative will be contacted to validate information given.

1.5.1.2 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting refrigerants must be certified as a Section 608 Technician to meet requirements in 40 CFR 82, Subpart F. Provide copies of technician certifications to the Contracting Officer at least 14 calendar days prior to work on any equipment containing these refrigerants.

If all products do not contain any refrigerants identified in 40 CFR 82, submit all refrigerant SDS sheets and a general statement of exemption from 40 CFR 82 in alternate to the certifications. Statement of exemption must indicate all equipment containing refrigerants with respective refrigerant types.

1.5.2 Standard Products

Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products must have been in satisfactory commercial or industrial use for 3 years immediately prior to the solicitation of this contract. The 3 year use includes applications of equipment and materials under similar circumstances and of similar size. The 3 years' experience must be satisfactorily completed by a product which has been sold on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products must be supported by a service organization. Ensure system components are environmentally suitable for the indicated geographic locations.

1.5.3 Manufacturer's Engineering Data

Submit VRF manufacturer's engineering data with the shop drawings under separate cover. Strike out irrelevant items and options not to be installed. Provide all input and output reports for all selection procedures required by the manufacturer and as required by this section. Engineering data must include:

a. Selection Procedures:

- (1) Indoor and Outdoor Units
- (2) Branch Selector Units
- (3) Piping Material and Fittings
- (4) Refrigerant Mass for system
- (5) Refrigerant Classification

b. System Efficiency Curves/Data including:

- (1) Efficiency correlated with OAT
- (2) At least five (5) data points covering full range of operation
- (3) Minimum and maximum values over the operational range
- (4) Efficiency at Standard AHRI conditions.

1.5.4 Manufacturer's Instructions

Submit VRF manufacturer's instructions with the shop drawings under separate cover. Strike out irrelevant items and options not to be installed. Provide with the following:

- a. Installation: Include mechanical, electrical, controls and piping complete installation requirements.
- b. Operation: Include startup, normal operation and shutdown procedures.
- c. Maintenance: Include preventative.

1.6 PROJECT SEQUENCING

Project sequencing must be in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.7 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Properly protect and care for all material both before and during installation. Submit an inventory of all the stored items. Replace any materials found to be damaged, at no additional cost to the Government. During installation, keep piping and similar openings capped to keep out dirt and other foreign matter.

1.8 WARRANTY

Provide VRF manufactured equipment with the Manufacturer's Standard Warranty. Submit Sample Warranty prior to construction. Compare warranty requirements with the requirements of this contract and identify discrepancies in the submittal that would prevent coverage of warranty by the manufacturer.

PART 2 PRODUCTS

All products used to meet this specification must meet the indicated requirements, but not all products specified here will be required by every project.

2.1 MATERIALS

Provide Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, in adequate detail to demonstrate compliance with contract requirements. If field installed vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit data for each specified component. Minimum efficiency requirements must be in accordance with ASHRAE 90.1 - IP.

2.1.1 Performance Requirements

2.1.1.1 Energy Efficiency

Provide equipment meeting the efficiency requirements as stated within this section and provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph ENERGY EFFICIENT PRODUCTS.

Provide energy efficiency curve and data of EFFICIENCY vs. OAT. Provide at least five data points over the full range of operation capturing the minimums and maximums.

2.1.1.1.1 Variable Refrigerant Flow Multi-Split Air Conditioners

Information on Energy Star requirements can be found at https://www.energystar.gov/products/heating_cooling/light_commercial_heating_cooling/light_commercial_hvac_key_product_criteria

2.1.1.1.2 Electrical Equipment / Motors

Provide electrical equipment, motors, motor efficiencies, and wiring which are in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical motor driven equipment specified must be provided complete with motors, motor starters, and controls. Electrical characteristics must be as shown, and unless otherwise indicated and field wiring must be in accordance with manufacturer's instructions. All motor(s):

- a. 1 horsepower and above must be the premium efficiency type in accordance with NEMA MG 1.
- b. Conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating.
- c. Continuous duty with the enclosure specified.
- d. Starters must be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated.
- e. Furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer.
- f. Duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop.
- g. Must be sized for all applicable loads.
- h. Bearings with grease supply fittings must have grease relief to outside of enclosure.
- i. Automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, must be provided.

2.1.1.1.3 Refrigerant

Refrigerants must have number designations and safety classifications in accordance with ANSI/ASHRAE 15 & 34. Refrigerants must have an Ozone

Depletion Potential (ODP) no greater than 0.0, with the exception of R-123. Provide Refrigerant SDS sheets for all refrigerants.

2.1.2 Safety Devices

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices.

2.2 CONTROLS

The control system, components and network must be in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

2.2.1 Zone Control

Provide a Space Sensor Module, in accordance with Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, for each fan coil unit unless otherwise indicated in contract drawings and with the following additional requirements:

- a. Displays the current temperature, temperature setpoint, fans status, occupancy status and conditioning mode at the same time. If information is displayed electronically then it must be illuminated.
- b. Temperature setpoint adjustment in one degree increments.
- c. Fans speed control (At least: High-low-Auto).

2.3 INDOOR FAN COIL UNITS

Provide with the following:

- a. Factory complete, tested and pre-wired with all necessary electronic and refrigerant controls.
- b. Equipped with auto-restart function and test run capability either via a switch or controller.
- c. Refrigerant: Refrigerant circuits factory-charged with dehydrated inert gas.
- d. Coils: Direct expansion type constructed from copper, aluminum, or copper and aluminum.
- e. Fans: Direct-drive, with statically and dynamically balanced impellers; variable speed ECM unless otherwise indicated; motor thermally protected.
- f. Return Air Filter: Washable long-life net filter with mildew proof resin, or replaceable, unless otherwise indicated.
- g. Condensate Drainage: Built-in condensate drain pan with drain connection.
- h. Dedicated electronic modulating refrigerant expansion and flow control.
- i. Unit must be in accordance with UL 1995 and AHRI 1230.

- j. For units with Built-In Condensate Pumps, provide condensate safety shutoff and alarm. For units without Built-In Condensate Pump, provide built in or field supplied overflow protection.

2.3.1 Wall Surface-Mounted Units

Provide with the following:

- a. Finished white casing, with removable front grille; sound insulation; wall mounting plate; condensate drain pan.
- b. Airflow Control: Auto-swing louver that closes automatically when unit stops; adjustable discharge angle, set using remote controller; upon restart, discharge angle defaulting to same angle as previous operation.
- c. Fan: Direct-drive cross-flow type.
- d. Condensate Drain Connection: Side (end), not concealed in wall.

2.4 OUTDOOR COMPRESSOR UNIT

Provide with the following:

- a. The outdoor unit must have one or more variable capacity compressors or alternative method resulting in three or more steps of capacity needed to load match the indoor unit fan coils at all times.
- b. The unit must be factory complete, tested and pre-wired with all necessary electronic and refrigerant controls.
- c. The sound pressure dB(A) at rated conditions must be a value of 58 decibels at 3 feet from the front of the unit when rated in accordance with ANSI/AHRI 270.
- d. The unit must automatically restart normal operation after a power failure of any duration without reprogramming or manual assistance.
- e. Oil recovery cycle must be automatic occurring a minimum of 2 hours after start of operation and then at least every 8 hours of operation.
- f. Each outdoor unit must have it's own dedicated power feed, each with disconnect and main power circuit breaker.
- h. The unit must be in compliance with ANSI/ASHRAE 15 & 34, factory tested, cleaned, dehydrated, charged, and sealed. Provide refrigerant charging valves. Filter-drier must be provided in liquid line.
- i. The outdoor units capacity must meet or exceed the scheduled value in the contract drawings. The ratio of the outdoor unit capacity to the total connected indoor capacity must be in accordance with the manufacturer's recommendations for selecting the outdoor unit.
- j. Unit must be in accordance with UL 1995 and AHRI 1230.

2.4.1 Air-Cooled

- a. The unit must must have full design cooling capacity at 92 degrees F

dry bulb ambient.

- b. For units other than cooling only, the unit must have full design heating capacity at 10 degrees F dry bulb ambient.

2.4.2 Casing

Construct the unit of zinc coated, heavy-gage (14-gage minimum) galvanized steel. Provide cabinet panels with lifting handles and water- and air-tight seal. Insulate all exposed vertical panels, top covers and base pan.

2.4.3 Compressor

Each compressor system must have the following:

- a. High pressure safety switch, and internal thermal overload protection.
- b. Factory installed vibration dampeners on all mounting points.
- d. Factory installed crank case heater or other control logic to ensure reliable operation in freezing environments.
- e. Oil separator with an oil balance circuit.

2.5 COMPONENTS

2.5.1 Fans

Fan wheel shafts must be supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans must be selected to produce the flow rate required at the fan total pressure. Motor starters, if applicable, must be magnetic across-the-line type with a drip-proof enclosure. Thermal overload protection must be of the manual or automatic-reset type. Fan wheels or propellers must be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings must be of galvanized steel, and both centrifugal and propeller fan casings must be constructed of aluminum or galvanized steel. Steel elements of fans, except fan shafts, must be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting must be recoated with an approved zinc-rich compound. Fan wheels or propellers must be statically and dynamically balanced. Direct-drive fan motors must be of the multiple-speed variety. Belt-driven fans are prohibited. Propeller fans must be direct-drive drive type with fixed pitch blades. V-belt driven fans must be mounted on a corrosion protected drive shaft supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Each drive will be independent of any other drive. Drive bearings must be protected with water slingers or shields.

2.5.2 Air Filters

Air filters must be listed in accordance with requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency must be as listed under the label service and must meet the requirements of UL 586.

2.5.3 Coil Frost Protection (Defrost Mode)

Provide each circuit with a manufacturer's standard coil frost protection (Defrost Mode) system.

2.5.4 Pressure Vessels

Pressure vessels must conform to ASME BPVC SEC VIII D1 or UL 207, as applicable for maximum and minimum pressure or temperature encountered. Where referenced publications do not apply, test pressure components at 1-1/2 times design working pressure.

2.5.4.1 Liquid Receiver

Receiver must be rated in accordance with the recommendations of ANSI/AHRI 495.

2.5.4.2 Suction Accumulator

Accumulators must comply with UL 207. Accumulators over 6 inch in diameter must comply with ASME BPVC SEC VIII.

2.5.4.2.1 Vertical Type

Provide heat exchanger or heating element around the U-tube in freezing environments.

2.5.4.2.2 Horizontal Type

Provide only in non-freezing environments.

2.5.4.3 Oil Separator

Separator must be the high efficiency type and be provided with removable flanged head for ease in removing float assembly and removable screen cartridge assembly. Connections to compressor must be as recommended by the compressor manufacturer. Separator must be provided with an oil float valve assembly or needle valve and orifice assembly, drain line shutoff valve, sight glass and strainer. Provide an oil separator for each refrigerant circuit.

2.5.4.4 Oil Reservoir

Reservoir capacity must equal one charge of all connected compressors. Reservoir must be provided with an external liquid gauge glass, plugged drain, and isolation valves. Vent piping between the reservoir and the suction header must be provided with a 5 psi pressure differential relief valve. Reservoir must be provided with the manufacturer's standard filter on the oil return line to the oil level regulators.

2.5.5 Internal Dampers

Dampers must be parallel blade type with renewable blade seals and be integral to the unitary unit. Damper provisions must be provided for each outside air intake, exhaust, economizer, and mixing boxes. Dampers must have minimum position stops and operate as specified.

2.5.6 Refrigerant Piping

2.5.6.1 Copper Tubing

Copper tubing shall conform to ASTM B280 annealed or hard drawn as required. Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing shall not be used in sizes larger than 1-3/8 inches. Joints must be brazed except that joints on lines 7/8 inch and smaller may be flared. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B62. Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings shall not be allowed for brazed joints. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

2.5.6.2 Brazing Filler Metal

Filler metal shall conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.5.7 Condensate Drain Piping

Provide condensate drain piping in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.5.8 Ductwork

Provide interface to ductwork in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

2.5.9 Refrigerant Solenoid Valves

Solenoid valves must comply with ANSI/AHRI 760 and UL 429, be suitable for continuous duty rated voltage at maximum and minimum encountered pressure and temperature service conditions. Solenoid valves must be direct-acting or pilot-operating type, packless, seal capped. Manual lifting provisions must be furnished. Solenoid coils must comply with NEMA 250 type 4. Valves must have safe working pressure of 125 percent of maximum working pressure and a maximum operating pressure differential of at least half of the valve maximum working pressure at 85 percent rated voltage. Valves must have an operating pressure differential suitable for the fluid phase and refrigerant used.

2.6 EQUIPMENT ACCESSORIES AND MISCELLANEOUS EQUIPMENT

2.6.1 Refrigerant Relief Valve/Rupture Disc Assembly

The assembly must be a combination pressure relief valve and rupture disc designed for refrigerant usage. The assembly must be in accordance with ASME BPVC SEC VIII D1 and ANSI/ASHRAE 15 & 34. The assembly must be provided with a pressure gauge assembly which will provide local indication if a rupture disc is broken. Rupture disc must be the non-fragmenting type.

2.6.2 Refrigerant Signs

Refrigerant signs must be a medium-weight aluminum type with a baked

enamel finish. Signs must be suitable for indoor or outdoor service. Signs must have a white background with red letters not less than 0.5 inches in height.

2.6.2.1 Installation Identification

Provide each new refrigeration system with a refrigerant sign which indicates the following as a minimum:

- a. Contractor's name.
- b. Refrigerant number and amount of refrigerant.
- c. The lubricant identity and amount.
- d. Field test pressure applied.

2.6.2.2 Controls and Piping Identification

Provide refrigerant systems containing more than 110 lb of refrigerant with refrigerant signs which designate the following as a minimum:

- a. Valves or switches for controlling the refrigerant flow and the refrigerant compressor.
- b. Pressure limiting device(s).

2.6.3 Gaskets

Provide gaskets conforming to ASTM F104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.6.4 Bolts and Nuts

Bolts and nuts must be in accordance with ASTM A307. The bolt head must be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A307.

2.7 FINISHES

2.7.1 Coil Corrosion Protection

Provide coil with a uniformly applied phenolic type coating to all coil surface areas without material bridging between fins. Submit product data on the type coating selected, the coating thickness, the application process used, the estimated heat transfer loss of the coil, and verification of conformance with the salt spray test requirement. Coating must be applied at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation. Coating must be capable of withstanding a minimum 6,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.7.2 Equipment and Components Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, must be factory finished with the manufacturer's standard finish, except that items located outside of buildings must have weather resistant finishes that will withstand 6,000 hours exposure to the

salt spray test specified in ASTM B117. Immediately after completion of the test, the specimen must show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used must be coated with a zinc-rich coating conforming to ASTM D520, Type I.

Where stipulated in equipment specifications of this section, coat finned tube coils of the affected equipment as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating must show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins.

2.7.2.1 Phenolic Coating

Provide a resin base thermosetting phenolic coating. Apply coating by immersion dipping of the entire coil. Provide a minimum of two coats. Bake or heat dry coils following immersions. After final immersion and prior to final baking, spray entire coil with particular emphasis given to building up coating on sheared edges. Total dry film thickness must be 2.5 to 3.0 mils.

2.7.3 Factory Applied Insulation

Refrigeration equipment must be provided with factory installed insulation on surfaces subject to sweating including the suction line piping. Where motors are the gas-cooled type, factory installed insulation must be provided on the cold-gas inlet connection to the motor in accordance with manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors must have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces must have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes must be determined by ASTM E84. Insulation must be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket must be tested as a composite material. Jackets, facings, and adhesives must have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E84.

2.8 TESTS, INSPECTIONS, AND VERIFICATIONS

All manufactured units must be inspected and tested, and documentation provided to demonstrate that each unit is in compliance with applicable ANSI/AHRI and UL requirements and that the minimum efficiency requirements of ASHRAE 90.1 - IP have been met.

PART 3 EXECUTION

3.1 INSTALLATION

The VRF system must be installed by the contractor identified in Qualification Of Installer. The contractor must install the VRF system in accordance with the manufacturer's instructions and Shop Drawings.

3.1.1 Equipment General

Provide necessary supports for all equipment, appurtenances, and pipe as required. Isolate outdoor units from the building structure. If mechanical vibration isolators are not provided, provide vibration absorbing foundations. Each foundation must include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block must be of mass not less than three times the equipment weight. Concrete for foundations must be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Equipment must be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions. Air-source outdoor units must be installed per manufacturer's recommendations and must not blow air in the direction of other outdoor unit intakes.

3.1.2 Safety Devices

Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.

3.1.3 Controls

Install Controls in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC, as indicated by the Points Schedule and to provide the following functionality:

- a. On/Off selection for each individual fan coil unit and group.
- b. Temperature set point adjustment for each fan coil unit.
- c. Fan speed adjustment for each fan coil.
- d. Heat/cool/automatic changeover mode selection for indoor and outdoor units.
- e. Priority settings for restriction of local access for start/stop, heat/cool mode and set point adjustment.
- f. Temperature limitation in both heating and cooling mode.
- g. Weekly occupancy schedule with start up and shut off times, temperature settings and operation modes. Yearly occupancy schedule for holidays and periods of non-use.
- h. Reset for non-blocking malfunction codes and maintenance warnings.

Provide a Local Display panel as indicated on the points schedule and to provide access to the above specified functionality. The Local Display Panel must additionally indicate current date and time.

3.1.4 Valves

3.1.4.1 General

Refrigerant stop valves shall be installed on each side of each piece of

equipment such as compressors condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Stop valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches shall be external to thermal insulation. Safety switches shall not be fitted with isolation valves. Filter dryers having access ports may be considered a point of isolation. Purge valves shall be provided at all points of systems where accumulated noncondensable gases would prevent proper system operation. Valves shall be furnished to match line size, unless otherwise indicated or approved.

3.1.4.2 Expansion Valves

Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 2-1/8 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2-1/8 inches. The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall be installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

3.1.5 Electrical Equipment / Motors

Install electrical equipment, motors, motor efficiencies, and wiring in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.6 Condensate Removal

Provide condensate removal through gravity flow where possible. Where gravity flow is not possible, provide a condensate pump sufficient ensure complete removal of condensate.

3.1.7 Access Panels

Provide access panels for all concealed equipment, valves, controls, dampers, refrigerant fittings, and other fittings for inspection, maintenance and removal. Size panel large enough as to be able to remove the part without modification or damage to the surroundings.

3.1.8 Air Filters

Allow access space for servicing filters. Install filters with suitable sealing to prevent bypassing of air. Perform and document that proper indoor air quality during construction procedures have been followed in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING, paragraph Indoor Air Quality During Construction; this includes providing documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed.

3.1.9 Flashing and Pitch Pockets

Provide flashing and pitch pockets for equipment supports and roof penetrations and flashing where piping or ductwork passes through exterior walls in accordance with Section 07 60 00 FLASHING AND SHEET METAL.

3.1.10 Identification Tags and Plates

Provide equipment, gages, thermometers, valves, and controllers with tags numbers stamped or engraved into the material for their use. Provide plates and tags of brass or suitable nonferrous rigid material, securely mounted or attached. Provide minimum letter and numeral size of 1/8 inch high.

3.1.11 Refrigerant Signs

Locate refrigerant signs within reading distance of outdoor unit.

3.1.12 Field Applied Insulation

Apply field applied insulation as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.13 Piping

3.1.13.1 Pipe Hangers and Supports

Design and fabrication of pipe hangers, supports, and welding attachments must conform to MSS SP-58. Installation of hanger types and supports for bare and covered pipes must conform to MSS SP-58 for the system temperature range. Unless otherwise indicated, horizontal and vertical piping attachments must conform to MSS SP-58.

3.1.13.2 Refrigerant Piping

Cut pipe to measurements established at the site and work into place without springing or forcing. Install piping with sufficient flexibility to provide for expansion and contraction due to temperature fluctuation and as indicated in shop drawings. Where pipe passes through building structure pipe joints must not be concealed, but must be located where they may be readily inspected. Install piping to be insulated with sufficient clearance to permit application of insulation. Install piping as indicated and detailed, to avoid interference with other piping, conduit, or equipment. Except where specifically indicated otherwise, run piping plumb and straight and parallel to walls and ceilings. Provide sleeves of suitable size for lines passing through building structure. Braze refrigerant piping with silver solder complying with AWS A5.8/A5.8M. Inside of tubing and fittings must be free of flux. Clean parts to be jointed with emery cloth and keep hot until solder has penetrated full depth of fitting and extra flux has been expelled. Cool joints in air and remove flame marks and traces of flux. During brazing operation, prevent oxide film from forming on inside of tubing by slowly flowing dry nitrogen through tubing to expel air. Make provisions to automatically return oil on halocarbon systems. Installation of piping must comply with ASME B31.5. All refrigerant lines external to units must have field applied insulation per Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS unless otherwise indicated.

All refrigerant lines external to units must be isolated from system vibrations including those generated by compressors, fans, or pumps, to minimize the risk of refrigerant leaks.

3.1.13.3 Solenoid Valve Installation

Install liquid solenoid valves in horizontal lines with stem vertical and

with flow in direction indicated on valve. If not incorporated as integral part of the valve, provide a strainer upstream of the solenoid valve. Provide service valves upstream of the solenoid valve, upstream of the strainer, and downstream of the solenoid valve. Remove the internal parts of the solenoid valve when brazing the valve.

3.1.14 Auxiliary Drain Pans, Drain Connections, And Drain Lines

Provide auxiliary drain pans under units located above finished ceilings or over mechanical or electrical equipment. Pan must extend beyond the limits of the units. Provide separate drain lines for the unit drain and auxiliary drain pans. Trap drain pans from the bottom to ensure complete pan drainage. Provide drain lines full size of drain opening. Traps and piping to drainage disposal points must conform to Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2 REFRIGERANT PIPING TESTS

After all components of the refrigerant system have been installed and connected, subject the entire refrigeration system to pneumatic, evacuation, and startup tests as described herein. Submit a schedule, at least 2 weeks prior to the start of related testing, for each test. Identify the proposed date, time, and location for each test. Conduct tests in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Provide all material, equipment, instruments, and personnel required for the test. Provide the services of a qualified technician, as required, to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Submit 6 copies of the tests report in bound 8 1/2 by 11 inch booklets documenting all phases of the tests performed. The report shall include initial test summaries, all repairs/adjustments made, and the final test results.

3.2.1 Preliminary Procedures

Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.

3.2.2 Pneumatic Test

Pressure control and excess pressure protection shall be provided at the source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage test shall be at 10 psi with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure specified in ASHRAE 15 & 34 with a maximum test pressure 25 percent greater. Pressure above 100 psig shall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24 hour period, the system

pressure will be recorded along with the ambient temperature to which the system is exposed. A correction factor of 0.3 psi will be allowed for each degree F change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If the corrected system pressure is not exactly equal to the initial system test pressure, then the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, remelting, or back-welding/brazing shall not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

3.2.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, the pressure shall be relieved and the entire system shall be evacuated to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed and the system shall stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, then the system shall be evacuated again down to 300 micrometers and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure continues to rise, check the system for leaks, repair as required, and repeat the evacuation procedure. During evacuation, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

3.2.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following refrigerant charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

3.2.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

3.3 SYSTEM PERFORMANCE TESTS

Before each VRF system is accepted, conduct tests to demonstrate the general operating characteristics of the VRF as directed by COR/COTR. Submit three bound copies of the report as 8-1/2 by 11 inch booklets. The report must document compliance with the specified performance criteria upon completion and testing of the system. The report must indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. Include manufacturer commissioning report for each VRF system.

For equipment providing heating and cooling the system performance tests must be performed during the heating and cooling seasons. For systems capable of simultaneous heating and cooling, perform testing of this mode.

- a. Submit a schedule, at least 2 weeks prior to the start of related testing, for the system performance tests. The schedules must identify the proposed date, time, and location for each test. Tests must cover a period of not less than 48 hours for each system and must demonstrate that the entire system is functioning in accordance with the drawings and specifications.
- b. Make corrections and adjustments, as necessary, tests must be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, install and tighten service valve seal caps and blanks over gauge points.
- c. If tests do not demonstrate satisfactory system performance, correct deficiencies and retest the system. Conduct tests in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Provide all material, equipment, instruments, and personnel required for the test.
- d. Coordinate field tests with Section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Submit 3 copies of the report provided in bound 8-1/2 by 11 inch booklets. The report must document compliance with the specified performance criteria upon completion and testing of the system. The report must indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. Submit the report including the following information (where values are taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart):

(1) Date and outside weather conditions.

(2) The load on the system based on the following:

- (a) The refrigerant used in the system.
- (b) Condensing temperature and pressure.
- (c) Suction temperature and pressure.
- (d) Ambient, condensing and coolant temperatures.
- (e) Running current, voltage and proper phase sequence for each phase of all motors.

(3) The actual on-site setting of operating and safety controls.

(4) Electronic expansion valve superheat - value as determined by field test.

(5) Subcooling.

(6) High and low refrigerant temperature switch set-points

(7) Low oil pressure switch set-point.

(8) Defrost system timer and thermostat set-points.

(9) Moisture content.

- (10) Capacity control set-points.
- (11) Field data and adjustments which affect unit performance and energy consumption.
- (12) Field adjustments and settings which were not permanently marked as an integral part of a device.

3.4 CLEANING

Equipment must be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters must be provided for all fans that are operated during construction, and new filters must be installed after all construction dirt has been removed from the building. System must be maintained in this clean condition until final acceptance. Bearings must be properly lubricated with oil or grease as recommended by the manufacturer. Belts must be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment must be adjusted to setting indicated or directed. Fans must be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.5 CLOSEOUT ACTIVITIES

Provide closeout activities in addition to and in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS.

3.5.1 Extra Materials

Submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

3.5.2 Maintenance Service Providers

Submit a certified list of qualified permanent service organizations, which includes their addresses and qualifications, for support of the equipment. The service organizations must be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

3.5.3 Warranty

Submit warranty certificate to the Contracting Officer. Provide warranty management plan in accordance with 01 78 00 CLOSEOUT SUBMITTALS.

3.5.4 VRF Operation And Maintenance Manual

Provide the following in addition to and accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC:

- a. Condensed operating instructions listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown.

- b. Manufacturer's Engineering Data.
- c. Manufacturer's Instructions.
- d. Shop Drawings on 11 by 17 inches sheets.

3.5.5 Posted Instructions

Submit the field posted instructions, at least 2 weeks prior to construction completion. Including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions on one sheet of paper. The condensed operation instructions must include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions must cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations. The posted instructions must be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

3.5.6 Training

Provide training, for all items provided under this section, in addition to and accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. Also include refrigeration leak detection and leak detection response training. The training period must consist of a total 8 hours of normal working time for items covered in this section.

-- End of Section --

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SECTION 23 82 00.00 20

TERMINAL HEATING UNITS

02/16, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z83.8/CSA 2.6 (2016; Errata 2017) Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters, and Gas-Fired Duct Furnaces

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 33 (2016) Method of Testing Forced Circulation Air Cooling and Air Heating Coils

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM B117 (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM D1654 (2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2 (2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 6 (1993; R 2016) Industrial Control and Systems: Enclosures

NEMA MG 1 (2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (2021) National Fuel Gas Code

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 90B	(2021) Standard for the Installation of Warm Air Heating and Air Conditioning Systems
NFPA 91	(2020) Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids
NFPA 211	(2019) Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

UNDERWRITERS LABORATORIES (UL)

UL 441	(2016; Reprint Jul 2016) UL Standard for SafetyGas Vents
UL 1042	(2009; Reprint Feb 2021) UL Standard for Safety Electric Baseboard Heating Equipment

1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Hydronic Cabinet Unit Heaters And Unit Heaters; G

Hydronic Radiator; G

Gas-Fired Unit Heater; G

Electric Baseboard Units; G

SD-10 Operation and Maintenance Data

Hydronic Cabinet Unit Heaters And Unit Heaters, Data Package 2

Hydronic Radiator; G

Gas-Fired Unit Heater; G

Electric Baseboard Units; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 HYDRONIC CABINET UNIT HEATERS AND UNIT HEATERS

Self-contained and factory assembled, propeller fans for unit heaters and centrifugal fan for cabinet unit heaters with capacities expressed as Btu per hour output and cubic foot-per-minute air delivery, operating conditions, and mounting arrangements as indicated. Average fan bearing life must be minimum 200,000 hours at operating conditions. Provide fan motor with direct drive. Construct fan-guard motor mount of steel wire. Equip each heater with individually adjustable package discharge louver. Louvers may be substituted by discharge cones or diffusers. Provide thermostats as indicated on drawings. Furnish circuit breaker disconnect switch.

2.1.1 Hot-Water Unit Heater

ASHRAE 33 tested for heating coils; UL listed for motor and controls.

2.1.1.1 Casing

Minimum 20 gage steel with removable access panels or means to remove, service, and maintain major components.

2.1.1.2 Coil

Fin-and-tube coil constructed of copper and copper or aluminum fins. Use maximum design pressure of hot water at 125 psig and 200 degrees F.

2.1.1.3 Controls

Provide automatic controls as indicated on drawings.

2.2 GAS-FIRED UNIT HEATER

ANSI Z83.8/CSA 2.6 and AGA label.

2.2.1 Casing

Minimum 22 gage steel. Provide removable access panels.

2.2.2 Heat Exchanger

Minimum 20 gage all-welded steel construction with corrosion-resistant aluminum finish.

2.2.3 Burners

Die-formed, slot ports, and steel construction with aluminum paint.

2.2.4 Draft Diverter

All-welded steel construction and an integral part of each heat exchanger section. Allows backdrafts to bypass burner assembly without affecting normal operation.

2.2.5 Controls

Consisting of a combination pressure regulator, two-stage gas valve in 100

percent and 55 percent of full rating, main shutoff valve, pilot cock, pilot safety switch for 100 percent shutoff, high temperature limit switch, and time-delay fan switch. Include power and control connections in an integral junction box.

2.2.6 Efficiency

Unit heater must have a minimum combustion efficiency of 80 percent when tested in accordance with ANSI Z83.8/CSA 2.6.

2.2.7 Accessories

Provide automatic electric pilot recognition kit.

2.3 HYDRONIC RADIATOR

Provide steel panel hydronic radiator elements of lengths, capacities, styles and having accessories as scheduled. Radiator to be wall or floor mounted type, constructed of one-piece all-welded steel construction, consisting of flattened water tubes welded to headers at each end. The radiator headers shall include all necessary inlet, outlet and vent connections as required. Connection sizes shall be 1/2-inch NPT minimum for supply and return piping, and 1/8-inch for vent connection. Provide with internal baffling to ensure proper water flow. Radiator shall be rated for minimum working pressure of 85 PSI and have a maximum thermal expansion of 1/64-inch per foot. Provide with heavy gauge perforated top grille. The radiator shall have powder coat finish. Color shall be per architect.

2.4 ELECTRIC BASEBOARD UNITS

UL 1042; wattage, voltage, phase, Btu per hour output indicated. Provide units complete with heating elements, mounting brackets, end closures, splice plates, interior and exterior corners and accessible wiring compartment. Limit outlet air temperature and enclosure surfaces to 200 degrees F under continuous operating conditions.

2.4.1 Enclosure

Fabricate from steel or aluminum not less than 18 gage. Provide factory applied rust-inhibiting paint manufacturer's standard finish. Locate terminal blocks for branch circuit conductor and control wiring connections as required. Wiring shall conform to NFPA 70.

2.4.2 Accessories

Where continuous wall-to-wall installations are indicated, provide accessories; including corner fittings, fillers, splice plates, and end caps. Accessories shall have the same profile as the basic unit, and contain no sharp edges.

2.4.3 Limit Control

Provide thermal overload and over voltage protection.

2.4.4 Disconnect Means

Provide factory-installed safety disconnect switch in the housing with "off" position marking on the face plate.

2.4.5 Unit Thermostat

Provide tamper resistant integral tool adjustable thermostat, without requiring removal of cabinet parts. Thermostat, operating range shall be approximately 50 degrees F to a maximum of 75 degrees F with operating differential of 3 degrees F or less.

2.5 FAN

Provide steel or aluminum fans with ball or roller bearings for motors over 1/8 horsepower (hp) and sleeve bearings for motors 1/8 hp and under. Provide sleeve bearings with oil reservoir, if not permanently lubricated.

2.6 MOTOR AND STARTER

NEMA MG 1, and NEMA ICS 2, and NEMA ICS 6, respectively. Provide continuous-duty motor with built-in automatic reset thermal overload protection. For motor 1/2 hp and larger, use three-phase. Provide single-phase motor of permanent split capacitor or capacitor start. Limit motor speed at 1800 r/min. Wire motor to heater power supply source.

2.7 GAS PIPING SYSTEM AND FLUE VENT

Comply with Section 23 11 20 FACILITY GAS PIPING for gas valves and piping. Use UL 441 flue vents and gas-vent roof jacks, of stainless steel.

2.8 HOT WATER PIPING SYSTEMS

Section 23 21 13.00 20 LOW TEMPERATURE WATER (LTW) HEATING SYSTEM.

2.9 SOURCE QUALITY CONTROL

Special protection is not required for equipment that has a zinc coating conforming to ASTM A123/A123M. Otherwise, protect affected equipment items by manufacturers' corrosion-inhibiting coating or paint system that has proved capable of withstanding salt-spray test in accordance with ASTM B117. Test indoor equipment for 500 hours; test outdoor equipment for 6,000 hours. For each specimen, perform a scratch test as defined in ASTM D1654.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment where indicated and as recommended by manufacturer's recommendations, NFPA 54, NFPA 90A, NFPA 90B, NFPA 91 and NFPA 211.

3.1.1 Suspensions of Equipment

Provide equipment supports including beam clamps, turnbuckles and twist links or weld-wire chains, wire ropes with rope clips and rope thimbles, threaded-eye rod hangers with lock nuts and heat-duct hangers, threaded-eye bolts with expansion screws, brackets, platform and mounting frame, and vibration isolators. Locate equipment in such a manner that working space is available for servicing, such as vacuum pump and burner removal, access to automatic controls, and lubrication. Provide electrical isolation of dissimilar metals. Clean interior of casings or cabinets before and after completion of installation.

3.1.2 Vents

NFPA 54 and NFPA 211. Provide vents with weatherproofing flashings in accordance with Section 07 60 00 FLASHING AND SHEET METAL.

3.1.3 Electrical Work

NFPA 70 and Division 26, "ELECTRICAL." When replacing original control wires, provide No. 16 AWG with minimum 105 degrees C insulation.

3.1.4 Baseboard Heaters

Verify manufacturer's clearance requirements from electrical cords, drapes, and other furnishings.

3.2 FIELD QUALITY CONTROL

Administer, schedule, and conduct specified tests. Furnish personnel, instruments and equipment for such tests. Correct defects and repeat the respective inspections and tests. Conduct inspections and testing in the presence of the Contracting Officer.

3.2.1 Test Instruments and Apparatus

Provide instruments and apparatus currently certified as being accurate to within one percent of their full scale. Use gages with a maximum scale between 1 1/2 and 2 times test pressure.

3.2.2 Field Inspection

Prior to initial operation, inspect equipment installation to ensure that indicated and specified requirements have been met.

3.2.3 Field Tests

3.2.3.1 Fire Tests for Nonelectrical Heating Equipment

Test combustion controls and equipment with specified fuel at 100 percent full rated load. During tests, verify proper operation of controls. Adjust burners for maximum efficiency using Orsat or similar apparatus. Maintain firing for at least four hours, and where high-low-off combustion controls are provided, operate the heating equipment for one hour at low fire and 3 hours at high fire. For acceptable combustion efficiency, allow maximum 4.5 percent carbon dioxide in flue gases.

3.2.3.2 Operational Tests

After completing fire tests and insulation-resistance tests, operate equipment continuously under varying load conditions to verify functioning of combustion controls, electrical controls, flame safeguard controls, safety interlocks, and specified operating sequence. Run each test for a minimum period of one hour.

-- End of Section --

SECTION 25 05 11.01.01

CYBERSECURITY FOR BUILDING AUTOMATION SYSTEM

PART 1 GENERAL

Many subparts in this Section contain text in curly braces ("{" and "}") indicating which cybersecurity control and control correlation identifier (CCI) the requirements of the subpart relate to. The text inside these curly braces is for Government reference only, and enables coordination of the requirements of this Section with the RMF process throughout the design and construction process. Text in curly braces are not contractor requirements.

This Section refers to Security Requirements Guide (SRGs) and Security Technical Implementation Guide (STIGs). STIGs and SRGs are available online at the Information Assurance Support Environment (IASE) website at <http://iase.disa.mil/stigs/Pages/index.aspx>. Not all control system components have applicable STIGs or SRGs.

1.1 CONTROL SYSTEM APPLICABILITY

There are multiple versions of this Section associated with this project. Different versions have requirements applicable to different control systems. This specific Section applies only to the following control systems: BUILDING AUTOMATION SYSTEM.

1.2 RELATED REQUIREMENTS

All Sections containing facility-related control systems or control system components are related to the requirements of this Section. Review all specification sections to determine related requirements.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 8551.01	(2014) Ports, Protocols, and Services Management (PPSM)
DTM 08-060	(2008) Policy on Use of Department of Defense (DoD) Information Systems - Standard Consent Banner and User Agreement

1.4 DEFINITIONS

1.4.1 Computer

As used in this Section, a computer is one of the following:

- a. a device running a non-embedded desktop or server version of Microsoft Windows
- b. a device running a non-embedded version of MacOS
- c. a device running a non-embedded version of Linux
- d. a device running a version or derivative of the Android OS, where Android is considered separate from Linux
- e. a device running a version of Apple iOS

1.4.2 Network Connected

A component is network connected (or "connected to a network") only when the device has a network transceiver which is directly connected to the network and implements the network protocol. A device lacking a network transceiver (and accompanying protocol implementation) can never be considered network connected. Note that a device connected to a non-IP network is still considered network connected (an IP connection or IP address is not required for a device to be network connected).

Any device that supports wireless communication is network connected, regardless of whether the device is communicating using wireless.

1.4.3 User Account Support Levels

The support for user accounts is categorized in this Section as one of three levels:

1.4.3.1 FULLY Supported

Device supports configurable individual accounts. Accounts can be created, deleted, modified, etc. Privileges can be assigned to accounts.

1.4.3.2 MINIMALLY Supported

Device supports a small, fixed number of accounts (perhaps only one). Accounts cannot be modified. A device with only a "User" and an "Administrator" account would fit this category. Similarly, a device with two PINs for logon - one for restricted and one for unrestricted rights would fit here (in other words, the accounts do not have to be the traditional "user name and password" structure).

1.4.3.3 NOT Supported

Device does not support any Access Enforcement therefore the whole concept of "account" is meaningless.

1.4.4 User Interface

Generally, a user interface is hardware on a device allowing user interaction with that device via input (buttons, switches, sliders, keyboard, touch screen, etc.) and a screen. There are three types of user interfaces defined in this Section: Limited Local User Interface, Full Local User Interface and Remote User Interface. In this Section, when the term "User Interface" is used without specifying which type, it refers only to Full Local User Interface and Remote User Interface (NOT to

Limited Local User Interface).

1.4.4.1 Limited Local User Interface

A Limited Local User Interface is a user interface where the interaction is limited, fixed at the factory, and cannot be modified in the field. The user must be physically at the device to interact with it.

Examples of Limited Local User Interface include thermostats (Space Sensor Modules as defined in Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC).

1.4.4.2 Full Local User Interface

A Full Local User Interface is a user interface where the interaction and displays are field-configurable.

Examples of a Full Local User Interface include local applications on a computer and user interfaces to Variable Speed Drives.

1.4.4.3 Remote User Interface

A Remote User Interface is a user interface on a Client device allowing user interaction with a different Server device. The user need not be physically at the Server device to interact with it.

Examples of Remote User Interfaces include web browsers and Local Display Panels as defined in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.5 ADMINISTRATIVE REQUIREMENTS

1.5.1 Coordination

Coordinate the execution of this Section with the execution of all other Sections related to control systems as indicated in the paragraph RELATED REQUIREMENTS. Items that must be considered when coordinating project efforts include but are not limited to:

- a. If requesting permission for wireless communication, the Wireless Communication Request submittal must be approved prior to control system device selection and integration.
- b. If requesting permission for alternate account lock permissions, the Device Account Lock Exception Request must be approved prior to control system device selection and integration.
- c. If requesting permission for the use of a device with multiple IP connections, the Multiple IP Connection Device Request must be approved prior to control system device selection and integration.
- d. Wireless testing may be required as part of the control system testing. See requirements for the Wireless Communication Test Report submittal.
- e. If the Device Audit Record Upload Software is to be installed on a computer not being provided as part of the control system, coordination is required to identify the computer on which to install the software.

- g. Cybersecurity testing support must be coordinated across control systems and with the Government cybersecurity testing schedule.
- h. Passwords must be coordinated with the indicated contact for the project site.
- i. If applicable, HTTP web server certificates must be obtained from the indicated contact for the project site.
- j. Contractor Computer Cybersecurity Compliance Statements for each contractor using contractor owned computers.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Wireless Communication Request; G

Device Account Lock Exception Request; G

Multiple IP Connection Device Request; G

Contractor Computer Cybersecurity Compliance Statements; G

Contractor Temporary Network Cybersecurity Compliance Statements; G

SD-02 Shop Drawings

User Interface Banner Schedule; G

Network Communication Report; G

Cybersecurity Riser Diagram; G

Control System Inventory Report; G

SD-03 Product Data

Control System Cybersecurity Documentation; G

SD-06 Test Reports

Wireless Communication Test Report; G

SD-07 Certificates

Software Licenses; G

SD-11 Closeout Submittals

Password Summary Report; G

Software Recovery And Reconstitution Images; G

Device Audit Record Upload Software; G

1.7 CYBERSECURITY DOCUMENTATION

1.7.1 Network Communication Report

{For Reference Only: This subpart (and its subparts) relates to CA-9; CCI-002102, CCI-002103, CCI-002104, CCI-002105 and also the submittal requirements associated with CM-6, CM-7 and SC-41}

Provide a network communication report. For each networked controller, document the communication characteristics of the controller including communication protocols, services used, and a general description of what information is communicated over the network. For each controller using IP, document all TCP and UDP ports used. If other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Network Communication Report as an editable Microsoft Excel file.

1.7.2 Control System Inventory Report

{For Reference Only: This subpart (and its subparts) relates to CM-8(a), CP-12, SI-17, IA-3; CCI-000389, CCI-000392, CCI-000398, CCI-002855, CCI-002856, CCI-002857, CCI-002773, CCI-002774, CCI-002775, CCI-000777, CCI-000778, CCI-001958}

Provide a Control System Inventory report using the Inventory Spreadsheet listed under this Section at

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic> documenting all devices, including networked devices, network infrastructure devices, non-networked devices, input devices (e.g. sensors) and output devices (e.g. actuators). For each device provide all applicable information for which there is a field on the spreadsheet in accordance with the instructions on the spreadsheet.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Control System Inventory Report as an editable Microsoft Excel file.

1.7.3 Software Recovery and Reconstitution Images

{For Reference Only: This subpart (and its subparts) relates to CP-10; CCI-000550, CCI-000551, CCI-000552}

For each computer on which software is installed under this project, provide a recovery image of the final as-built computer. This image must allow for bare-metal restore such that restoration of the image is sufficient to restore system operation to the imaged state without the need for re-installation of software.

1.7.4 Cybersecurity Riser Diagram

{For Reference Only: This subpart (and its subparts) relates to PL-2(a); CCI-003051, CCI-003053}

Provide a cybersecurity riser diagram of the complete control system

including all network and controller hardware. If the control system specifications require a riser diagram submittal, provide a copy of that submittal as the cybersecurity riser diagram. Otherwise, provide a riser diagram in one-line format.

1.7.5 Control System Cybersecurity Documentation

This subpart (and its subparts) relates to SA-5 (a),(b),(c); CCIs:
CCI-003124, CCI-003125, CCI-003126, CCI-003127, CCI-003128, CCI-003129,
CCI-003130, CCI-003131}

Provide a Control System Cybersecurity Documentation submittal containing the indicated information for each device and software application.

1.7.5.1 Software Applications

For all software applications running on computers provide:

- a. administrator documentation that describes secure configuration of the software {relates to CCI-003124}
- b. administrator documentation that describes secure installation of the software {relates to CCI-003125}
- c. administrator documentation that describes secure operation of the software {relates to CCI-003124}
- d. administrator documentation that describes effective use and maintenance of security functions or mechanisms for the software {relates to CCI-003127}
- e. administrator documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the software {relates to CCI-003128}
- f. user documentation that describes user-accessible security functions or mechanisms in the software and how to effectively use those security functions or mechanisms {relates to CCI-003129}
- g. user documentation that describes methods for user interaction which enables individuals to use the software in a more secure manner {relates to CCI-003130}
- h. user documentation that describes user responsibilities in maintaining the security of the software {relates to CCI-003131}

1.7.5.2 For BAS System Devices

1.7.5.2.1 BAS System Devices FULLY Supporting User Accounts

For all BAS System Devices which FULLY support user accounts, provide:

- a. Documentation that describes secure configuration of the device {for reference only: relates to CCI-003124}
- b. Documentation that describes secure operation of the device {for reference only: relates to CCI-003124}

- c. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {for reference only: relates to CCI-003127}
- d. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {for reference only: relates to CCI-003128}
- e. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms; or a specific indication that there are no user-accessible security functions or mechanisms in the device {for reference only: relates to CCI-003129}
- f. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {for reference only: relates to CCI-003130}

1.7.5.2.2 All Other BAS Control System Devices

For all BAS Control System Devices which do not FULLY support user accounts, provide:

- a. Documentation that describes secure configuration of the device; or a specific indication that there are no secure configuration steps that apply {for reference only: relates to CCI-003124}
- b. Documentation that describes effective use and maintenance of security functions or mechanisms for the device; or a specific indication that there are no security functions or mechanisms in the device {for reference only: relates to CCI-003127}
- c. For devices which include a user interface, documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {for reference only: relates to CCI-003130}

1.7.5.3 Default Requirements for Control System Devices

For control system devices where Control System Cybersecurity Documentation requirements are not otherwise indicated in this Section, provide:

- a. Documentation that describes secure configuration of the device {for reference only: relates to CCI-003124}
- b. Documentation that describes secure installation of the device {for reference only: relates to CCI-003125}
- c. Documentation that describes secure operation of the device {for reference only: relates to CCI-003124}
- d. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {for reference only: relates to CCI-003127}
- e. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {for reference only: relates to CCI-003128}

- f. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms {for reference only: relates to CCI-003129}
- g. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {for reference only: relates to CCI-003130}
- h. Documentation that describes user responsibilities in maintaining the security of the device {for reference only: relates to CCI-003131}

1.8 SOFTWARE UPDATE LICENSING

{For Reference Only: This subpart (and its subparts) relates to SI-2 (a),(c); CCI-001227, CCI-002605}

In addition to all other licensing requirements, all software licensing must include licensing of the following software updates for a period of no less than 5 years:

- a. Security and bug-fix patches issued by the software manufacturer.
- b. Security patches to address any vulnerability identified in the National Vulnerability Database at <http://nvd.nist.gov> with a Common Vulnerability Scoring System (CVSS) severity rating of MEDIUM or higher.

Provide a single Software Licenses submittal with documentation of the software licenses for all software provided

1.9 CYBERSECURITY DURING CONSTRUCTION

{For Reference Only: This subpart (and its subparts) relates to AC-18, SA-3, CCI-00258}

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

1.9.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. When used, contractor computers must meet the following requirements:

1.9.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

1.9.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates, and must use the latest definitions file. All computers used on this project must be scanned using the installed software at least once per day.

1.9.1.3 Passwords and Passphrases

The passwords and passphrases for all computers must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.9.1.4 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using contractor owned computers. Contractor Computer Cybersecurity Compliance Statements must use the template published at <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic> Each Statement must be signed by a cybersecurity representative for the relevant company.

1.9.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks must meet the following requirements:

1.9.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than IP networks provided under this project or Government furnished IP networks provided for this purpose. Any and all network access from outside the project site is prohibited.

1.9.3 Government Access to Network

Government personnel must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification

1.9.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks must not interfere with existing wireless network and must use WPA2 security. Network names (SSID) for wireless networks must be changed from their default values.

1.9.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.9.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. Contractor Temporary Network Cybersecurity Compliance Statements must use the template published at <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic> Each Statement must be signed by a cybersecurity representative for the

relevant company. If no temporary IP networks will be used, provide a single copy of the Statement indicating this.

1.10 CYBERSECURITY DURING WARRANTY PERIOD

All work performed on the control system after acceptance must be performed using Government Furnished Equipment or equipment specifically and individually approved by the Government.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.1 ACCESS CONTROL REQUIREMENTS

3.1.1 User Accounts

{For Reference Only: This subpart (and its subparts) relate to AC-2(a) and AC-3; CCI-002110, CCI-000213.}

Any device supporting user accounts (either FULLY or MINIMALLY) must limit access to the device according to specified limitations for each account. Install and configure any device having a STIG or SRG in accordance with that STIG or SRG.

3.1.1.1 Computers

All computers must FULLY support user accounts.

3.1.1.2 For BAS Control System Devices

Devices with web interfaces must either FULLY support user accounts or have their web interface disabled. Field devices with full local user interfaces allowing modification of data must at least MINIMALLY support user accounts.

3.1.1.3 Default Requirements for Control System Devices

For control system devices where User Account requirements are not otherwise indicated in this Section:

- a. Devices with web interfaces must either FULLY support user accounts or have their web interface disabled.
- b. Field devices with full local user interfaces allowing modification of data must at least MINIMALLY support user accounts.
- c. Field devices with read-only full local user interfaces must at least MINIMALLY support user accounts.

3.1.2 Unsuccessful Logon Attempts

{For Reference Only: This subpart (and its subparts) relate AC-7 (a), AC-7 (b); CCI-000043, CCI-000044, CCI-001423, CCI-002236, CCI-002237, CCI-002238}

Except for high availability user interfaces indicated as exempt, devices must meet the indicated requirements for handling unsuccessful logon attempts.

3.1.2.1 Devices MINIMALLY Supporting Accounts

Devices which MINIMALLY support accounts are not required to lock based on unsuccessful logon attempts.

3.1.2.2 Devices FULLY Supporting Accounts

Devices which FULLY support accounts must meet the following requirements. If a device cannot meet these requirements, document device capabilities to protect from subsequent unsuccessful logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures without explicit permission from the Government.

- a. It must lock the user account when three unsuccessful logon attempts occur within a 15 minute interval.
- b. Once an account is locked, the account must stay locked until unlocked by an administrator.
- c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.1.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

All interfaces for this control system are exempt from unsuccessful logon attempt requirements.

3.1.3 System Use Notification

{For Reference Only: This subpart (and its subparts) relates to AC-8; CCI-000048, CCI-002247, CCI-002243, CCI-002244, CCI-002245, CCI-002246, CCI-000050, CCI-002248}

Web interfaces must display a warning banner meeting the requirements of DTM 08-060.

Devices which are connected to a network and have a user interface must display a warning banner meeting the requirements of DTM 08-060 if capable of doing so. Devices which are connected to a network and have a user interface but are not capable of displaying a banner must have a permanently affixed label displaying an approved banner from DTM 08-060. Labels must be machine printed or engraved, plastic or metal, designed for permanent installation, must use a font no smaller than 14 point, and must provide a high contrast between font and background colors.

3.1.3.1 User Interface Banner Schedule

Provide a User Interface Schedule using the format indicated showing each user interface provided and how the information banner requirement has been implemented for each user interface.

User Interface Schedule Format (with sample entries)			
User Interface Description	User Interface Location	Type of User Interface	Banner Implementation
Sample 1	Room 1	Remote	DTM 08-060 Banner "A" Displayed at Logon
Sample 2	Room 2	Limited Local	DTM 08-060 Banner "B" on Affixed Label
Sample 3	Room 3	Full Local	DTM 08-060 Banner "B" Displayed on Screen

3.1.4 Permitted Actions Without Identification or Authentication

{For Reference Only: This subpart (and its subparts) relates to AC-14; CCI-000061, CCI-000232}

The control system must require identification and authentication before allowing any actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.

3.1.5 Wireless Access

{For Reference Only: This subpart (and its subparts) relates to AC-18; CCI-001438, CCI-001439, CCI-002323, CCI-001441}

Unless explicitly authorized by the Government, do not use any wireless communication. Any device with wireless communication capability is considered to be using wireless communication, regardless of whether or not the device is actively communicating wirelessly, except when wireless communication has been physically permanently disabled (such as through the removal of the wireless transceiver).

3.1.5.1 Wireless IP Communications

Do not install wireless IP networks, including: do not install a wireless access point; do not install or configure an ad-hoc wireless network; do not install or configure a WiFi Direct communication.

When explicitly authorized by the Government, wireless IP communication may be used to communicate with an existing wireless network.

3.1.5.2 Non-IP Wireless Communication

When non-IP wireless communication is explicitly authorized by the Government, use the maximum level of encryption supported by the specific protocol employed and select signal strength and radiated power to the minimum necessary for reliable communication.

3.1.5.3 Wireless Communication Request

Provide a report documenting the proposed use of wireless communication prior to beginning construction using the Wireless Communication Request

Schedule at

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic>

For each device proposed to use wireless communication show: the device identifier, a description of the device, the location of the device, the device identifiers of other devices communicating with the device, the protocol used for communication, encryption type and strength, RF Frequency, Radiated Power in dBm (decibel with a milliwatt reference), free-space range, and the expected as-installed range.

3.1.5.4 Wireless Communication Testing

As part of Performance Verification Testing (PVT), conduct testing of wireless communication for all devices indicated on the approved Wireless Communication Request as requiring testing.

To test wireless communication, test for wireless network reception at multiple points along the wireless test boundary in the vicinity of the wireless device, and record whether a network connection can be established at each point. The wireless test boundary is the facility fence line. If wireless testing is required, provide a Wireless Communication Test Report documenting the testing points and results at each point for each wireless device.

3.2 CYBERSECURITY AUDITING

3.2.1 Audit Events, Content of Audit Records, and Audit Generation

{For Reference Only: This subpart (and its subparts) relates to AU-2(a),(c),(d), AU-3, AU-12; CCI-000123, CCI-001571, CCI-000125, CCI-001485, CCI-000130, CCI-000131, CCI-000132, CCI-00133, CCI-000134, CCI-001487, CCI-000169, CCI-001459, CCI-000171, CCI-000172, CCI-001910}

For devices that have STIG/SRGs related to audit events, content of audit records or audit generation, comply with the requirements of those STIG/SRGs.

3.2.1.1 Computers

For each computer, provide the capability to select audited events and the content of audit logs. Configure computers to audit the indicated events, and to record the indicated information for each auditable event

3.2.1.1.1 Audited Events

Configure each computer to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)
- b. Successful and unsuccessful logon attempts
- c. Privileged activities or other system level access
- d. Starting and ending time for user access to the system
- e. Concurrent logons from different workstations

- f. Successful and unsuccessful accesses to objects
- g. All program initiations
- h. All direct access to the information system
- i. All account creations, modifications, disabling, and terminations
- j. All kernel module load, unload, and restart

3.2.1.1.2 Audit Event Information To Record

Configure each computer to record, for each auditable event, the following information (where applicable to the event):

- a. What type of event occurred
- b. When the event occurred
- c. Where the event occurred
- d. The source of the event
- e. The outcome of the event
- f. The identity of any individuals or subjects associated with the event

3.2.1.2 For BAS Control System Devices

3.2.1.2.1 BAS Control System Devices FULLY Supporting User Accounts

For devices FULLY supporting accounts, provide the capability to select audited events, and the contents of audit logs. Configure devices to audit the following events:

- a. Successful and unsuccessful logon attempts to the device
- b. Starting and ending time for user access to the device
- c. All account creations, modifications, disabling, and terminations
- d. All device shutdown and startup

Configure the device to record for each event the following information (as applicable): the type of event, when the event occurred and the identity of any individuals or subjects associated with the event

3.2.1.2.2 Other BAS Control System Devices

There are no requirements to perform auditing at BAS field devices that do not FULLY support accounts.

3.2.1.3 Default Requirements for Control System Devices

For control system devices where Audit Events, Content of Audit Records, and Audit Generation are not otherwise indicated in this Section:

3.2.1.3.1 Devices Which FULLY Support Accounts

For each device which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure devices to audit the indicated events, and to record the indicated information for each auditable event

3.2.1.3.1.1 Audited Events

Configure each device to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)
- b. Successful and unsuccessful logon attempts
- c. Privileged activities or other system level access
- d. Starting and ending time for user access to the system
- e. Concurrent logons from different workstations
- f. All account creations, modifications, disabling, and terminations
- g. All kernel module load, unload, and restart

3.2.1.3.1.2 Audit Event Information To Record

Configure each computer to record, for each auditable event, the following information (where applicable to the event):

- a. what type of event occurred
- b. when the event occurred
- c. where the event occurred
- d. the source of the event
- e. the outcome of the event
- f. the identity of any individuals or subjects associated with the event

3.2.1.3.2 Devices Which Do Not FULLY Support Accounts

For each Device which does not FULLY support accounts configure the device to audit all device shutdown and startup events and to record for each event the type of event and when the event occurred.

3.2.2 Audit Storage Capacity and Audit Upload

{For Reference Only: This subpart (and its subparts) relates to AU-4; CCI-001848, CCI-001849}

- a. For devices that have STIG/SGRs related to audit storage capacity (CCI-001848 or CCI-001849) comply with the requirements of those STIG/SGRs.

- b. For non-computer control system devices capable of generating audit records, provide 60 days worth of secure local storage, assuming 10 auditable events per day.

3.2.2.1 Device Audit Record Upload Software

For each non-computer device required to audit events, provide, and license to the Government, software implementing a secure mechanism of uploading audit records from the device to a computer and of exporting the uploaded audit records as a Microsoft Excel file. Where different devices use different software, provide software of each type required to upload audit logs from all devices.

Submit copies of device audit record upload software. If there are no non-computer devices requiring auditing, provide a document stating this in lieu of this submittal.

3.2.3 Time Stamps

{For Reference Only: This subpart (and its subparts) relates to AU-8; CCI-000159, CCI-001889, CCI-001890}

3.2.3.1 Default Requirements for Control System Devices

For control system devices where Time Stamps requirements are not otherwise indicated in this Section: Devices generating audit records must have internal clocks capable of providing time with a resolution of 1 second. Clocks must not drift more than 10 seconds per day. Configure the system so that each device generating audit records maintains accurate time to within 1 second.

3.3 REQUIREMENTS FOR LEAST FUNCTIONALITY

{For Reference Only: This subpart (and its subparts), along with the network communication report submittal specified elsewhere in this section, relates to CM-6 (a), (c), CM-7, CM-7 (1)(b), SC-41; CCI-000363, CCI-000364, CCI-000365, CCI-001588, CCI-001755, CCI-000381, CCI-000380, CCI-00382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546.}

For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I/O access for least functionality), install and configure the device in accordance with that STIG or SRGs.

For DDC Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

For Other Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

3.3.1 Non-IP Control Networks

When control system specifications require particular communication protocols, use only those communication protocols and only as specified. Do not implement any other communication protocol, or use any protocol on ports other than those specified.

When control system specifications do not indicate requirements for communication protocols, use only those protocols required for operation of the system as specified.

3.3.2 IP Control Networks

Do not use nonsecure functions, ports, protocols and services as defined in DODI 8551.01 unless those ports, protocols and services are specifically required by the control system specifications or otherwise specifically authorized by the Government. Do not use ports, protocols and services that are not specified in the control system specifications or required for operation of the control system.

3.4 SAFE MODE AND FAIL SAFE OPERATION

{For Reference Only: This subpart (and its subparts) relates to CP-12, SI-17; CCI-002855, CCI-002856, CCI-002857, CCI-002773, CCI-002774, CCI-002775}

For all control system components with an applicable STIG or SRG, configure the component in accordance with all applicable STIGs and SRGs.

3.5 IDENTIFICATION AND AUTHENTICATION

3.5.1 User Identification and Authentication

{For Reference Only: This subpart (and its subparts) relates to IA-2,(1),(12); CCI-000764, CCI-000765, CCI-001953, CCI-001954}

- a. Devices that FULLY support accounts must uniquely identify and authenticate organizational users.
- b. Devices which allow network access to privileged accounts must implement multifactor authentication for network access to privileged accounts.

3.5.1.1 BAS Control Systems Devices

Identification and Authentication for network access to privileged accounts must be implemented by either accepting and electronically verify Personal Identity Verification (PIV) credentials or inheriting identification and authentication from the operating system.

3.5.1.2 Default Requirements for Control System Devices

For control system devices where User Identification and Authentication requirements are not otherwise indicated in this Section, User Identification and Authentication for network access to privileged accounts must be implemented by accepting and electronically verify Personal Identity Verification (PIV) credentials.

3.5.2 Authenticator Management

{For Reference Only: This subpart (and its subparts) relates to IA-5 (b),(c),(e),(g),(1),(11); CCI-000176, CCI-001544, CCI-001989, CCI-000182, CCI-001610, CCI-000192, CCI-000193, CCI-000194, CCI-000205, CCI-001619, CCI-001611, CCI-001612, CCI-001613, CCI-001614, CCI-000195, CCI-001615, CCI-000196, CCI-000197, CCI-000199, CCI-000198, CCI-001616, CCI-001617, CCI-000200, CCI-001618, CCI-002041, CCI-002002, CCI-002003}

3.5.2.1 Authentication Type

3.5.2.1.1 For BAS Control System Devices

Unless otherwise indicated:

- a. Software which FULLY supports accounts and which runs on a computer must use password-based authentication or hardware token-based authentication.
- b. Other devices which FULLY support accounts must use password-based authentication.
- c. Devices MINIMALLY supporting accounts must use password-based authentication.

3.5.2.1.2 Default Requirements for Control System Devices

For control system devices where Authentication Type requirements are not otherwise indicated in this Section:

- a. Software which FULLY supports accounts and which runs on a computer must use password-based authentication or hardware token-based authentication.
- b. Other devices which FULLY support accounts must use either password-based authentication or hardware token-based authentication.
- c. Devices MINIMALLY supporting accounts must use either password-based authentication or hardware token-based authentication.

3.5.2.2 Password-Based Authentication Requirements

3.5.2.2.1 Passwords for Computers

All computers supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character.
- f. Password must have a minimum lifetime of 24 hours.
- g. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- h. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters.
- i. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.2 Passwords for Non-Computer Devices FULLY Supporting Accounts

All non-computer devices FULLY supporting accounts and supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of twelve (12) characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character.
- f. Password must have a maximum lifetime of sixty (60) days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five (5) passwords, where differ is defined as changing at least fifty percent of the characters.
- h. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.3 Passwords for Web Interfaces

Passwords for connecting to a web interface supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character.
- f. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters.
- h. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.4 Passwords for Devices Minimally Supporting Accounts

Devices minimally supporting accounts must support passwords with a minimum length of four characters.

3.5.2.2.5 Password Configuration and Reporting

For all devices with a password, change the password from the default password. Do not use the same password for more than one device unless

specifically instructed to do so. Provide a Password Summary Report documenting the password for each device and describing the procedure to change the password for each device.

Do not provide the Password Summary Report in electronic format. Provide two hardcopies of the Password Summary Report, each copy in its own sealed envelope.

3.5.2.3 Hardware Token-Based Authentication Requirements

Devices supporting hardware token-based authentication must use Personal Identity Verification (PIV) credentials for the hardware token.

3.5.3 Authenticator Feedback

{For Reference Only: This subpart relates to IA-6; CCI-000206}

Devices must never show authentication information, including passwords, on a display. Devices that momentarily display a character as it is entered, and then obscure the character, are acceptable. For devices that have STIGs or SRGs related to obscuring of authenticator feedback (CCI-000206), comply with the requirements of those STIGs/SRGs.

3.6 EMERGENCY POWER

{For Reference Only: This subpart (and its subparts) relates to PE-11,(1); CCI-02955, CCI-000961}

Emergency power is specified in the control system and equipment specifications.

3.7 DURABILITY TO VULNERABILITY SCANNING

{For Reference Only: This subpart (and its subparts) relates to RA-5 (a),(b),(c),(d); CCI-001054, CCI-001055, CCI-0010156, CCI-001641, CCI-001643, CCI-001057, CCI-001058, CCI-001059}

All IP devices must be scannable, such that the device can be scanned by industry standard IP network scanning utilities without harm to the device, application, or functionality.

3.7.1 BAS Control System Devices Other Than Computers

BAS control system devices other than computers are not required to respond to scans.

3.7.2 Default Requirements for Control System Devices

Non-computer control system devices where Durability to Vulnerability are not required to respond to scans.

3.8 SYSTEM AND INTEGRATION INTEGRITY

3.8.1 Malicious Code Protection

{For Reference Only: This subpart (and its subparts) relates to SI-3(c); CCI-001241, CCI-002623}

For all computers installed under this project, install and configure

malware protection software in accordance with the relevant STIGs.

3.9 FIELD QUALITY CONTROL

3.9.1 Tests

In addition to testing and testing support required by other Sections, provide a minimum of 4 hours of technical support for cybersecurity testing of control systems.

-- End of Section --

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SECTION 25 05 11.02

CYBERSECURITY FOR DDC

PART 1 GENERAL

Many subparts in this Section contain text in curly braces ("{" and "}") indicating which cybersecurity control and control correlation identifier (CCI) the requirements of the subpart relate to. The text inside these curly braces is for Government reference only, and enables coordination of the requirements of this Section with the RMF process throughout the design and construction process. Text in curly braces are not contractor requirements.

This Section refers to Security Requirements Guide (SRGs) and Security Technical Implementation Guide (STIGs). STIGs and SRGs are available online at the Information Assurance Support Environment (IASE) website at <http://iase.disa.mil/stigs/Pages/index.aspx>. Not all control system components have applicable STIGs or SRGs.

1.1 CONTROL SYSTEM APPLICABILITY

There are multiple versions of this Section associated with this project. Different versions have requirements applicable to different control systems. This specific Section applies only to the following control systems: BUILDING AUTOMATION SYSTEM.

1.2 RELATED REQUIREMENTS

All Sections containing facility-related control systems or control system components are related to the requirements of this Section. Review all specification sections to determine related requirements.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 8551.01	(2014) Ports, Protocols, and Services Management (PPSM)
DTM 08-060	(2008) Policy on Use of Department of Defense (DoD) Information Systems - Standard Consent Banner and User Agreement

1.4 DEFINITIONS

1.4.1 Computer

As used in this Section, a computer is one of the following:

- a. a device running a non-embedded desktop or server version of Microsoft Windows
- b. a device running a non-embedded version of MacOS
- c. a device running a non-embedded version of Linux
- d. a device running a version or derivative of the Android OS, where Android is considered separate from Linux
- e. a device running a version of Apple iOS

1.4.2 Network Connected

A component is network connected (or "connected to a network") only when the device has a network transceiver which is directly connected to the network and implements the network protocol. A device lacking a network transceiver (and accompanying protocol implementation) can never be considered network connected. Note that a device connected to a non-IP network is still considered network connected (an IP connection or IP address is not required for a device to be network connected).

Any device that supports wireless communication is network connected, regardless of whether the device is communicating using wireless.

1.4.3 User Account Support Levels

The support for user accounts is categorized in this Section as one of three levels:

1.4.3.1 FULLY Supported

Device supports configurable individual accounts. Accounts can be created, deleted, modified, etc. Privileges can be assigned to accounts.

1.4.3.2 MINIMALLY Supported

Device supports a small, fixed number of accounts (perhaps only one). Accounts cannot be modified. A device with only a "User" and an "Administrator" account would fit this category. Similarly, a device with two PINs for logon - one for restricted and one for unrestricted rights would fit here (in other words, the accounts do not have to be the traditional "user name and password" structure).

1.4.3.3 NOT Supported

Device does not support any Access Enforcement therefore the whole concept of "account" is meaningless.

1.4.4 User Interface

Generally, a user interface is hardware on a device allowing user interaction with that device via input (buttons, switches, sliders, keyboard, touch screen, etc.) and a screen. There are three types of user interfaces defined in this Section: Limited Local User Interface, Full Local User Interface and Remote User Interface. In this Section, when the term "User Interface" is used without specifying which type, it refers only to Full Local User Interface and Remote User Interface (NOT to

Limited Local User Interface).

1.4.4.1 Limited Local User Interface

A Limited Local User Interface is a user interface where the interaction is limited, fixed at the factory, and cannot be modified in the field. The user must be physically at the device to interact with it.

Examples of Limited Local User Interface include thermostats (Space Sensor Modules as defined in Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC).

1.4.4.2 Full Local User Interface

A Full Local User Interface is a user interface where the interaction and displays are field-configurable.

Examples of a Full Local User Interface include local applications on a computer and user interfaces to Variable Speed Drives.

1.4.4.3 Remote User Interface

A Remote User Interface is a user interface on a Client device allowing user interaction with a different Server device. The user need not be physically at the Server device to interact with it.

Examples of Remote User Interfaces include web browsers and Local Display Panels as defined in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.5 ADMINISTRATIVE REQUIREMENTS

1.5.1 Coordination

Coordinate the execution of this Section with the execution of all other Sections related to control systems as indicated in the paragraph RELATED REQUIREMENTS. Items that must be considered when coordinating project efforts include but are not limited to:

- a. If requesting permission for wireless communication, the Wireless Communication Request submittal must be approved prior to control system device selection and integration.
- b. If requesting permission for alternate account lock permissions, the Device Account Lock Exception Request must be approved prior to control system device selection and integration.
- c. If requesting permission for the use of a device with multiple IP connections, the Multiple IP Connection Device Request must be approved prior to control system device selection and integration.
- d. Wireless testing may be required as part of the control system testing. See requirements for the Wireless Communication Test Report submittal.
- e. If the Device Audit Record Upload Software is to be installed on a computer not being provided as part of the control system, coordination is required to identify the computer on which to install the software.

- g. Cybersecurity testing support must be coordinated across control systems and with the Government cybersecurity testing schedule.
- h. Passwords must be coordinated with the indicated contact for the project site.
- i. If applicable, HTTP web server certificates must be obtained from the indicated contact for the project site.
- j. Contractor Computer Cybersecurity Compliance Statements for each contractor using contractor owned computers.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Wireless Communication Request; G

Device Account Lock Exception Request; G

Multiple IP Connection Device Request; G

Contractor Computer Cybersecurity Compliance Statements; G

Contractor Temporary Network Cybersecurity Compliance Statements; G

SD-02 Shop Drawings

User Interface Banner Schedule; G

Network Communication Report; G

Cybersecurity Riser Diagram; G

Control System Inventory Report; G

SD-03 Product Data

Control System Cybersecurity Documentation; G

SD-06 Test Reports

Wireless Communication Test Report; G

SD-07 Certificates

Software Licenses; G

SD-11 Closeout Submittals

Password Summary Report; G

Software Recovery And Reconstitution Images; G

Device Audit Record Upload Software; G

1.7 CYBERSECURITY DOCUMENTATION

1.7.1 Network Communication Report

{For Reference Only: This subpart (and its subparts) relates to CA-9; CCI-002102, CCI-002103, CCI-002104, CCI-002105 and also the submittal requirements associated with CM-6, CM-7 and SC-41}

Provide a network communication report. For each networked controller, document the communication characteristics of the controller including communication protocols, services used, and a general description of what information is communicated over the network. For each controller using IP, document all TCP and UDP ports used. If other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Network Communication Report as an editable Microsoft Excel file.

1.7.2 Control System Inventory Report

{For Reference Only: This subpart (and its subparts) relates to CM-8(a), CP-12, SI-17, IA-3; CCI-000389, CCI-000392, CCI-000398, CCI-002855, CCI-002856, CCI-002857, CCI-002773, CCI-002774, CCI-002775, CCI-000777, CCI-000778, CCI-001958}

Provide a Control System Inventory report using the Inventory Spreadsheet listed under this Section at <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic> documenting all devices, including networked devices, network infrastructure devices, non-networked devices, input devices (e.g. sensors) and output devices (e.g. actuators). For each device provide all applicable information for which there is a field on the spreadsheet in accordance with the instructions on the spreadsheet.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Control System Inventory Report as an editable Microsoft Excel file.

1.7.3 Software Recovery and Reconstitution Images

{For Reference Only: This subpart (and its subparts) relates to CP-10; CCI-000550, CCI-000551, CCI-000552}

For each computer on which software is installed under this project, provide a recovery image of the final as-built computer. This image must allow for bare-metal restore such that restoration of the image is sufficient to restore system operation to the imaged state without the need for re-installation of software.

1.7.4 Cybersecurity Riser Diagram

{For Reference Only: This subpart (and its subparts) relates to PL-2(a); CCI-003051, CCI-003053}

Provide a cybersecurity riser diagram of the complete control system including all network and controller hardware. If the control system specifications require a riser diagram submittal, provide a copy of that submittal as the cybersecurity riser diagram. Otherwise, provide a riser diagram in one-line format.

1.7.5 Control System Cybersecurity Documentation

This subpart (and its subparts) relates to SA-5 (a),(b),(c); CCIIs:
CCI-003124, CCI-003125, CCI-003126, CCI-003127, CCI-003128, CCI-003129,
CCI-003130, CCI-003131}

Provide a Control System Cybersecurity Documentation submittal containing the indicated information for each device and software application.

1.7.5.1 Software Applications

For all software applications running on computers provide:

- a. administrator documentation that describes secure configuration of the software {relates to CCI-003124}
- b. administrator documentation that describes secure installation of the software {relates to CCI-003125}
- c. administrator documentation that describes secure operation of the software {relates to CCI-003124}
- d. administrator documentation that describes effective use and maintenance of security functions or mechanisms for the software {relates to CCI-003127}
- e. administrator documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the software {relates to CCI-003128}
- f. user documentation that describes user-accessible security functions or mechanisms in the software and how to effectively use those security functions or mechanisms {relates to CCI-003129}
- g. user documentation that describes methods for user interaction which enables individuals to use the software in a more secure manner {relates to CCI-003130}
- h. user documentation that describes user responsibilities in maintaining the security of the software {relates to CCI-003131}

1.7.5.2 For DDC System Devices

1.7.5.2.1 DDC System Devices FULLY Supporting User Accounts

For all DDC System Devices which FULLY support user accounts, provide:

- a. Documentation that describes secure configuration of the device {for reference only: relates to CCI-003124}
- b. Documentation that describes secure operation of the device {for

reference only: relates to CCI-003124}

- c. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {for reference only: relates to CCI-003127}
- d. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {for reference only: relates to CCI-003128}
- e. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms; or a specific indication that there are no user-accessible security functions or mechanisms in the device {for reference only: relates to CCI-003129}
- f. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {for reference only: relates to CCI-003130}

1.7.5.2.2 All Other DDC Control System Devices

For all DDC Control System Devices which do not FULLY support user accounts, provide:

- a. Documentation that describes secure configuration of the device; or a specific indication that there are no secure configuration steps that apply {for reference only: relates to CCI-003124}
- b. Documentation that describes effective use and maintenance of security functions or mechanisms for the device; or a specific indication that there are no security functions or mechanisms in the device {for reference only: relates to CCI-003127}
- c. For devices which include a user interface, documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {for reference only: relates to CCI-003130}

1.7.5.3 Default Requirements for Control System Devices

For control system devices where Control System Cybersecurity Documentation requirements are not otherwise indicated in this Section, provide:

- a. Documentation that describes secure configuration of the device {for reference only: relates to CCI-003124}
- b. Documentation that describes secure installation of the device {for reference only: relates to CCI-003125}
- c. Documentation that describes secure operation of the device {for reference only: relates to CCI-003124}
- d. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {for reference only: relates to CCI-003127}
- e. Documentation that describes known vulnerabilities regarding

configuration and use of administrative (i.e. privileged) functions for the device {for reference only: relates to CCI-003128}

- f. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms {for reference only: relates to CCI-003129}
- g. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {for reference only: relates to CCI-003130}
- h. Documentation that describes user responsibilities in maintaining the security of the device {for reference only: relates to CCI-003131}

1.8 SOFTWARE UPDATE LICENSING

{For Reference Only: This subpart (and its subparts) relates to SI-2 (a),(c); CCI-001227, CCI-002605}

In addition to all other licensing requirements, all software licensing must include licensing of the following software updates for a period of no less than 5 years:

- a. Security and bug-fix patches issued by the software manufacturer.
- b. Security patches to address any vulnerability identified in the National Vulnerability Database at <http://nvd.nist.gov> with a Common Vulnerability Scoring System (CVSS) severity rating of MEDIUM or higher.

Provide a single Software Licenses submittal with documentation of the software licenses for all software provided

1.9 CYBERSECURITY DURING CONSTRUCTION

{For Reference Only: This subpart (and its subparts) relates to AC-18, SA-3, CCI-00258}

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

1.9.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. When used, contractor computers must meet the following requirements:

1.9.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

1.9.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates,

and must use the latest definitions file. All computers used on this project must be scanned using the installed software at least once per day.

1.9.1.3 Passwords and Passphrases

The passwords and passphrases for all computers must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.9.1.4 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using contractor owned computers. Contractor Computer Cybersecurity Compliance Statements must use the template published at <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic> Each Statement must be signed by a cybersecurity representative for the relevant company.

1.9.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks must meet the following requirements:

1.9.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than IP networks provided under this project or Government furnished IP networks provided for this purpose. Any and all network access from outside the project site is prohibited.

1.9.3 Government Access to Network

Government personnel must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification

1.9.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks must not interfere with existing wireless network and must use WPA2 security. Network names (SSID) for wireless networks must be changed from their default values.

1.9.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.9.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. Contractor Temporary Network Cybersecurity Compliance Statements must use the template published at

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic>
Each Statement must be signed by a cybersecurity representative for the relevant company. If no temporary IP networks will be used, provide a single copy of the Statement indicating this.

1.10 CYBERSECURITY DURING WARRANTY PERIOD

All work performed on the control system after acceptance must be performed using Government Furnished Equipment or equipment specifically and individually approved by the Government.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.1 ACCESS CONTROL REQUIREMENTS

3.1.1 User Accounts

{For Reference Only: This subpart (and its subparts) relate to AC-2(a) and AC-3; CCI-002110, CCI-000213.}

Any device supporting user accounts (either FULLY or MINIMALLY) must limit access to the device according to specified limitations for each account. Install and configure any device having a STIG or SRG in accordance with that STIG or SRG.

3.1.1.1 Computers

All computers must FULLY support user accounts.

3.1.1.2 For DDC Control System Devices

Devices with web interfaces must either FULLY support user accounts or have their web interface disabled. Field devices with full local user interfaces allowing modification of data must at least MINIMALLY support user accounts.

3.1.1.3 Default Requirements for Control System Devices

For control system devices where User Account requirements are not otherwise indicated in this Section:

- a. Devices with web interfaces must either FULLY support user accounts or have their web interface disabled.
- b. Field devices with full local user interfaces allowing modification of data must at least MINIMALLY support user accounts.
- c. Field devices with read-only full local user interfaces must at least MINIMALLY support user accounts.

3.1.2 Unsuccessful Logon Attempts

{For Reference Only: This subpart (and its subparts) relate AC-7 (a), AC-7 (b); CCI-000043, CCI-000044, CCI-001423, CCI-002236, CCI-002237,

CCI-002238}

Except for high availability user interfaces indicated as exempt, devices must meet the indicated requirements for handling unsuccessful logon attempts.

3.1.2.1 Devices MINIMALLY Supporting Accounts

Devices which MINIMALLY support accounts are not required to lock based on unsuccessful logon attempts.

3.1.2.2 Devices FULLY Supporting Accounts

Devices which FULLY support accounts must meet the following requirements. If a device cannot meet these requirements, document device capabilities to protect from subsequent unsuccessful logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures without explicit permission from the Government.

- a. It must lock the user account when three unsuccessful logon attempts occur within a 15 minute interval.
- b. Once an account is locked, the account must stay locked until unlocked by an administrator.
- c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.1.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

All interfaces for this control system are exempt from unsuccessful logon attempt requirements.

3.1.3 System Use Notification

{For Reference Only: This subpart (and its subparts) relates to AC-8; CCI-000048, CCI-002247, CCI-002243, CCI-002244, CCI-002245, CCI-002246, CCI-000050, CCI-002248}

Web interfaces must display a warning banner meeting the requirements of DTM 08-060.

Devices which are connected to a network and have a user interface must display a warning banner meeting the requirements of DTM 08-060 if capable of doing so. Devices which are connected to a network and have a user interface but are not capable of displaying a banner must have a permanently affixed label displaying an approved banner from DTM 08-060. Labels must be machine printed or engraved, plastic or metal, designed for permanent installation, must use a font no smaller than 14 point, and must provide a high contrast between font and background colors.

3.1.3.1 User Interface Banner Schedule

Provide a User Interface Schedule using the format indicated showing each user interface provided and how the information banner requirement has been implemented for each user interface.

User Interface Schedule Format (with sample entries)			
User Interface Description	User Interface Location	Type of User Interface	Banner Implementation
Sample 1	Room 1	Remote	DTM 08-060 Banner "A" Displayed at Logon
Sample 2	Room 2	Limited Local	DTM 08-060 Banner "B" on Affixed Label
Sample 3	Room 3	Full Local	DTM 08-060 Banner "B" Displayed on Screen

3.1.1.4 Permitted Actions Without Identification or Authentication

{For Reference Only: This subpart (and its subparts) relates to AC-14; CCI-000061, CCI-000232}

The control system must require identification and authentication before allowing any actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.

3.1.1.5 Wireless Access

{For Reference Only: This subpart (and its subparts) relates to AC-18; CCI-001438, CCI-001439, CCI-002323, CCI-001441}

Unless explicitly authorized by the Government, do not use any wireless communication. Any device with wireless communication capability is considered to be using wireless communication, regardless of whether or not the device is actively communicating wirelessly, except when wireless communication has been physically permanently disabled (such as through the removal of the wireless transceiver).

3.1.1.5.1 Wireless IP Communications

Do not install wireless IP networks, including: do not install a wireless access point; do not install or configure an ad-hoc wireless network; do not install or configure a WiFi Direct communication.

When explicitly authorized by the Government, wireless IP communication may be used to communicate with an existing wireless network.

3.1.1.5.2 Non-IP Wireless Communication

When non-IP wireless communication is explicitly authorized by the Government, use the maximum level of encryption supported by the specific protocol employed and select signal strength and radiated power to the minimum necessary for reliable communication.

3.1.1.5.3 Wireless Communication Request

Provide a report documenting the proposed use of wireless communication prior to beginning construction using the Wireless Communication Request

Schedule at

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic>

For each device proposed to use wireless communication show: the device identifier, a description of the device, the location of the device, the device identifiers of other devices communicating with the device, the protocol used for communication, encryption type and strength, RF Frequency, Radiated Power in dBm (decibel with a milliwatt reference), free-space range, and the expected as-installed range.

3.1.5.4 Wireless Communication Testing

As part of Performance Verification Testing (PVT), conduct testing of wireless communication for all devices indicated on the approved Wireless Communication Request as requiring testing.

To test wireless communication, test for wireless network reception at multiple points along the wireless test boundary in the vicinity of the wireless device, and record whether a network connection can be established at each point. The wireless test boundary is the facility fence line. If wireless testing is required, provide a Wireless Communication Test Report documenting the testing points and results at each point for each wireless device.

3.2 CYBERSECURITY AUDITING

3.2.1 Audit Events, Content of Audit Records, and Audit Generation

{For Reference Only: This subpart (and its subparts) relates to AU-2(a),(c),(d), AU-3, AU-12; CCI-000123, CCI-001571, CCI-000125, CCI-001485, CCI-000130, CCI-000131, CCI-000132, CCI-00133, CCI-000134, CCI-001487, CCI-000169, CCI-001459, CCI-000171, CCI-000172, CCI-001910}

For devices that have STIG/SRGs related to audit events, content of audit records or audit generation, comply with the requirements of those STIG/SRGs.

3.2.1.1 Computers

For each computer, provide the capability to select audited events and the content of audit logs. Configure computers to audit the indicated events, and to record the indicated information for each auditable event

3.2.1.1.1 Audited Events

Configure each computer to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)
- b. Successful and unsuccessful logon attempts
- c. Privileged activities or other system level access
- d. Starting and ending time for user access to the system
- e. Concurrent logons from different workstations

- f. Successful and unsuccessful accesses to objects
- g. All program initiations
- h. All direct access to the information system
- i. All account creations, modifications, disabling, and terminations
- j. All kernel module load, unload, and restart

3.2.1.1.2 Audit Event Information To Record

Configure each computer to record, for each auditable event, the following information (where applicable to the event):

- a. What type of event occurred
- b. When the event occurred
- c. Where the event occurred
- d. The source of the event
- e. The outcome of the event
- f. The identity of any individuals or subjects associated with the event

3.2.1.2 For DDC Control System Devices

3.2.1.2.1 DDC Control System Devices FULLY Supporting User Accounts

For devices FULLY supporting accounts, provide the capability to select audited events, and the contents of audit logs. Configure devices to audit the following events:

- a. Successful and unsuccessful logon attempts to the device
- b. Starting and ending time for user access to the device
- c. All account creations, modifications, disabling, and terminations
- d. All device shutdown and startup

Configure the device to record for each event the following information (as applicable): the type of event, when the event occurred and the identity of any individuals or subjects associated with the event

3.2.1.2.2 Other DDC Control System Devices

There are no requirements to perform auditing at DDC field devices that do not FULLY support accounts.

3.2.1.3 Default Requirements for Control System Devices

For control system devices where Audit Events, Content of Audit Records, and Audit Generation are not otherwise indicated in this Section:

3.2.1.3.1 Devices Which FULLY Support Accounts

For each device which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure devices to audit the indicated events, and to record the indicated information for each auditable event

3.2.1.3.1.1 Audited Events

Configure each device to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)
- a. Successful and unsuccessful logon attempts
- b. Privileged activities or other system level access
- c. Starting and ending time for user access to the system
- d. Concurrent logons from different workstations
- e. All account creations, modifications, disabling, and terminations
- f. All kernel module load, unload, and restart

3.2.1.3.1.2 Audit Event Information To Record

Configure each computer to record, for each auditable event, the following information (where applicable to the event):

- a. what type of event occurred
- b. when the event occurred
- c. where the event occurred
- d. the source of the event
- e. the outcome of the event
- f. the identity of any individuals or subjects associated with the event

3.2.1.3.2 Devices Which Do Not FULLY Support Accounts

For each Device which does not FULLY support accounts configure the device to audit all device shutdown and startup events and to record for each event the type of event and when the event occurred.

3.2.2 Audit Storage Capacity and Audit Upload

{For Reference Only: This subpart (and its subparts) relates to AU-4; CCI-001848, CCI-001849}

- a. For devices that have STIG/SRGs related to audit storage capacity (CCI-001848 or CCI-001849) comply with the requirements of those STIG/SRGs.

- b. For non-computer control system devices capable of generating audit records, provide 60 days worth of secure local storage, assuming 10 auditable events per day.

3.2.2.1 Device Audit Record Upload Software

For each non-computer device required to audit events, provide, and license to the Government, software implementing a secure mechanism of uploading audit records from the device to a computer and of exporting the uploaded audit records as a Microsoft Excel file. Where different devices use different software, provide software of each type required to upload audit logs from all devices.

Submit copies of device audit record upload software. If there are no non-computer devices requiring auditing, provide a document stating this in lieu of this submittal.

3.2.3 Time Stamps

{For Reference Only: This subpart (and its subparts) relates to AU-8; CCI-000159, CCI-001889, CCI-001890}

3.2.3.1 Default Requirements for Control System Devices

For control system devices where Time Stamps requirements are not otherwise indicated in this Section: Devices generating audit records must have internal clocks capable of providing time with a resolution of 1 second. Clocks must not drift more than 10 seconds per day. Configure the system so that each device generating audit records maintains accurate time to within 1 second.

3.3 REQUIREMENTS FOR LEAST FUNCTIONALITY

{For Reference Only: This subpart (and its subparts), along with the network communication report submittal specified elsewhere in this section, relates to CM-6 (a), (c), CM-7, CM-7 (1)(b), SC-41; CCI-000363, CCI-000364, CCI-000365, CCI-001588, CCI-001755, CCI-000381, CCI-000380, CCI-00382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546.}

For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I/O access for least functionality), install and configure the device in accordance with that STIG or SRGs.

For DDC Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

For Other Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

3.3.1 Non-IP Control Networks

When control system specifications require particular communication protocols, use only those communication protocols and only as specified. Do not implement any other communication protocol, or use any protocol on ports other than those specified.

When control system specifications do not indicate requirements for communication protocols, use only those protocols required for operation of the system as specified.

3.3.2 IP Control Networks

Do not use nonsecure functions, ports, protocols and services as defined in DODI 8551.01 unless those ports, protocols and services are specifically required by the control system specifications or otherwise specifically authorized by the Government. Do not use ports, protocols and services that are not specified in the control system specifications or required for operation of the control system.

3.4 SAFE MODE AND FAIL SAFE OPERATION

{For Reference Only: This subpart (and its subparts) relates to CP-12, SI-17; CCI-002855, CCI-002856, CCI-002857, CCI-002773, CCI-002774, CCI-002775}

For all control system components with an applicable STIG or SRG, configure the component in accordance with all applicable STIGs and SRGs.

3.5 IDENTIFICATION AND AUTHENTICATION

3.5.1 User Identification and Authentication

{For Reference Only: This subpart (and its subparts) relates to IA-2,(1),(12); CCI-000764, CCI-000765, CCI-001953, CCI-001954}

- a. Devices that FULLY support accounts must uniquely identify and authenticate organizational users.
- b. Devices which allow network access to privileged accounts must implement multifactor authentication for network access to privileged accounts.

3.5.1.1 DDC Control Systems Devices

Identification and Authentication for network access to privileged accounts must be implemented by either accepting and electronically verify Personal Identity Verification (PIV) credentials or inheriting identification and authentication from the operating system.

3.5.1.2 Default Requirements for Control System Devices

For control system devices where User Identification and Authentication requirements are not otherwise indicated in this Section, User Identification and Authentication for network access to privileged accounts must be implemented by accepting and electronically verify Personal Identity Verification (PIV) credentials.

3.5.2 Authenticator Management

{For Reference Only: This subpart (and its subparts) relates to IA-5 (b),(c),(e),(g),(1),(11); CCI-000176, CCI-001544, CCI-001989, CCI-000182, CCI-001610, CCI-000192, CCI-000193, CCI-000194, CCI-000205, CCI-001619, CCI-001611, CCI-001612, CCI-001613, CCI-001614, CCI-000195, CCI-001615, CCI-000196, CCI-000197, CCI-000199, CCI-000198, CCI-001616, CCI-001617, CCI-000200, CCI-001618, CCI-002041, CCI-002002, CCI-002003}

3.5.2.1 Authentication Type

3.5.2.1.1 For DDC Control System Devices

Unless otherwise indicated:

- a. Software which FULLY supports accounts and which runs on a computer must use password-based authentication or hardware token-based authentication.
- b. Other devices which FULLY support accounts must use password-based authentication.
- c. Devices MINIMALLY supporting accounts must use password-based authentication.

3.5.2.1.2 Default Requirements for Control System Devices

For control system devices where Authentication Type requirements are not otherwise indicated in this Section:

- a. Software which FULLY supports accounts and which runs on a computer must use password-based authentication or hardware token-based authentication.
- b. Other devices which FULLY support accounts must use either password-based authentication or hardware token-based authentication.
- c. Devices MINIMALLY supporting accounts must use either password-based authentication or hardware token-based authentication.

3.5.2.2 Password-Based Authentication Requirements

3.5.2.2.1 Passwords for Computers

All computers supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character.
- f. Password must have a minimum lifetime of 24 hours.
- g. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- h. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters.
- i. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.2 Passwords for Non-Computer Devices FULLY Supporting Accounts

All non-computer devices FULLY supporting accounts and supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of twelve (12) characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character.
- f. Password must have a maximum lifetime of sixty (60) days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five (5) passwords, where differ is defined as changing at least fifty percent of the characters.
- h. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.3 Passwords for Web Interfaces

Passwords for connecting to a web interface supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character.
- f. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters.
- h. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.4 Passwords for Devices Minimally Supporting Accounts

Devices minimally supporting accounts must support passwords with a minimum length of four characters.

3.5.2.2.5 Password Configuration and Reporting

For all devices with a password, change the password from the default password. Do not use the same password for more than one device unless

specifically instructed to do so. Provide a Password Summary Report documenting the password for each device and describing the procedure to change the password for each device.

Do not provide the Password Summary Report in electronic format. Provide two hardcopies of the Password Summary Report, each copy in its own sealed envelope.

3.5.2.3 Hardware Token-Based Authentication Requirements

Devices supporting hardware token-based authentication must use Personal Identity Verification (PIV) credentials for the hardware token.

3.5.3 Authenticator Feedback

{For Reference Only: This subpart relates to IA-6; CCI-000206}

Devices must never show authentication information, including passwords, on a display. Devices that momentarily display a character as it is entered, and then obscure the character, are acceptable. For devices that have STIGs or SRGs related to obscuring of authenticator feedback (CCI-000206), comply with the requirements of those STIGS/SRGs.

3.6 EMERGENCY POWER

{For Reference Only: This subpart (and its subparts) relates to PE-11,(1); CCI-02955, CCI-000961}

Emergency power is specified in the control system and equipment specifications.

3.7 DURABILITY TO VULNERABILITY SCANNING

{For Reference Only: This subpart (and its subparts) relates to RA-5 (a),(b),(c),(d); CCI-001054, CCI-001055, CCI-0010156, CCI-001641, CCI-001643, CCI-001057, CCI-001058, CCI-001059}

All IP devices must be scannable, such that the device can be scanned by industry standard IP network scanning utilities without harm to the device, application, or functionality.

3.7.1 DDC Control System Devices Other Than Computers

DDC control system devices other than computers are not required to respond to scans.

3.7.2 Default Requirements for Control System Devices

Non-computer control system devices where Durability to Vulnerability are not required to respond to scans.

3.8 SYSTEM AND INTEGRATION INTEGRITY

3.8.1 Malicious Code Protection

{For Reference Only: This subpart (and its subparts) relates to SI-3(c); CCI-001241, CCI-002623}

For all computers installed under this project, install and configure

malware protection software in accordance with the relevant STIGs.

3.9 FIELD QUALITY CONTROL

3.9.1 Tests

In addition to testing and testing support required by other Sections, provide a minimum of 4 hours of technical support for cybersecurity testing of control systems.

-- End of Section --

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SECTION 25 05 11.03

CYBERSECURITY FOR ESS

PART 1 GENERAL

Many subparts in this Section contain text in curly braces ("{" and "}") indicating which cybersecurity control and control correlation identifier (CCI) the requirements of the subpart relate to. The text inside these curly braces is for Government reference only, and enables coordination of the requirements of this Section with the RMF process throughout the design and construction process. Text in curly braces are not contractor requirements.

This Section refers to Security Requirements Guide (SRGs) and Security Technical Implementation Guide (STIGs). STIGs and SRGs are available online at the Information Assurance Support Environment (IASE) website at <http://iase.disa.mil/stigs/Pages/index.aspx>. Not all control system components have applicable STIGs or SRGs.

1.1 CONTROL SYSTEM APPLICABILITY

There are multiple versions of this Section associated with this project. Different versions have requirements applicable to different control systems. This specific Section applies only to the following control systems: ESS.

1.2 RELATED REQUIREMENTS

All Sections containing facility-related control systems or control system components are related to the requirements of this Section. Review all specification sections to determine related requirements.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 8551.01	(2014) Ports, Protocols, and Services Management (PPSM)
DTM 08-060	(2008) Policy on Use of Department of Defense (DoD) Information Systems - Standard Consent Banner and User Agreement

1.4 DEFINITIONS

1.4.1 Computer

As used in this Section, a computer is one of the following:

- a. a device running a non-embedded desktop or server version of Microsoft Windows
- b. a device running a non-embedded version of MacOS
- c. a device running a non-embedded version of Linux
- d. a device running a version or derivative of the Android OS, where Android is considered separate from Linux
- e. a device running a version of Apple iOS

1.4.2 Network Connected

A component is network connected (or "connected to a network") only when the device has a network transceiver which is directly connected to the network and implements the network protocol. A device lacking a network transceiver (and accompanying protocol implementation) can never be considered network connected. Note that a device connected to a non-IP network is still considered network connected (an IP connection or IP address is not required for a device to be network connected).

Any device that supports wireless communication is network connected, regardless of whether the device is communicating using wireless.

1.4.3 User Account Support Levels

The support for user accounts is categorized in this Section as one of three levels:

1.4.3.1 FULLY Supported

Device supports configurable individual accounts. Accounts can be created, deleted, modified, etc. Privileges can be assigned to accounts.

1.4.3.2 MINIMALLY Supported

Device supports a small, fixed number of accounts (perhaps only one). Accounts cannot be modified. A device with only a "User" and an "Administrator" account would fit this category. Similarly, a device with two PINs for logon - one for restricted and one for unrestricted rights would fit here (in other words, the accounts do not have to be the traditional "user name and password" structure).

1.4.3.3 NOT Supported

Device does not support any Access Enforcement therefore the whole concept of "account" is meaningless.

1.4.4 User Interface

Generally, a user interface is hardware on a device allowing user interaction with that device via input (buttons, switches, sliders, keyboard, touch screen, etc.) and a screen. There are three types of user interfaces defined in this Section: Limited Local User Interface, Full Local User Interface and Remote User Interface. In this Section, when the term "User Interface" is used without specifying which type, it refers only to Full Local User Interface and Remote User Interface (NOT to

Limited Local User Interface).

1.4.4.1 Limited Local User Interface

A Limited Local User Interface is a user interface where the interaction is limited, fixed at the factory, and cannot be modified in the field. The user must be physically at the device to interact with it.

Examples of Limited Local User Interface include thermostats (Space Sensor Modules as defined in Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC).

1.4.4.2 Full Local User Interface

A Full Local User Interface is a user interface where the interaction and displays are field-configurable.

Examples of a Full Local User Interface include local applications on a computer and user interfaces to Variable Speed Drives.

1.4.4.3 Remote User Interface

A Remote User Interface is a user interface on a Client device allowing user interaction with a different Server device. The user need not be physically at the Server device to interact with it.

Examples of Remote User Interfaces include web browsers and Local Display Panels as defined in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.5 ADMINISTRATIVE REQUIREMENTS

1.5.1 Coordination

Coordinate the execution of this Section with the execution of all other Sections related to control systems as indicated in the paragraph RELATED REQUIREMENTS. Items that must be considered when coordinating project efforts include but are not limited to:

- a. If requesting permission for wireless communication, the Wireless Communication Request submittal must be approved prior to control system device selection and integration.
- b. If requesting permission for alternate account lock permissions, the Device Account Lock Exception Request must be approved prior to control system device selection and integration.
- c. If requesting permission for the use of a device with multiple IP connections, the Multiple IP Connection Device Request must be approved prior to control system device selection and integration.
- d. Wireless testing may be required as part of the control system testing. See requirements for the Wireless Communication Test Report submittal.
- e. If the Device Audit Record Upload Software is to be installed on a computer not being provided as part of the control system, coordination is required to identify the computer on which to install the software.

- g. Cybersecurity testing support must be coordinated across control systems and with the Government cybersecurity testing schedule.
- h. Passwords must be coordinated with the indicated contact for the project site.
- i. If applicable, HTTP web server certificates must be obtained from the indicated contact for the project site.
- j. Contractor Computer Cybersecurity Compliance Statements for each contractor using contractor owned computers.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Wireless Communication Request; G

Device Account Lock Exception Request; G

Multiple IP Connection Device Request; G

Contractor Computer Cybersecurity Compliance Statements; G

Contractor Temporary Network Cybersecurity Compliance Statements; G

SD-02 Shop Drawings

User Interface Banner Schedule; G

Network Communication Report; G

Cybersecurity Riser Diagram; G

Control System Inventory Report; G

SD-03 Product Data

Control System Cybersecurity Documentation; G

SD-06 Test Reports

Wireless Communication Test Report; G

SD-07 Certificates

Software Licenses; G

SD-11 Closeout Submittals

Password Summary Report; G

Software Recovery And Reconstitution Images; G

Device Audit Record Upload Software; G

1.7 CYBERSECURITY DOCUMENTATION

1.7.1 Network Communication Report

{For Reference Only: This subpart (and its subparts) relates to CA-9; CCI-002102, CCI-002103, CCI-002104, CCI-002105 and also the submittal requirements associated with CM-6, CM-7 and SC-41}

Provide a network communication report. For each networked controller, document the communication characteristics of the controller including communication protocols, services used, and a general description of what information is communicated over the network. For each controller using IP, document all TCP and UDP ports used. If other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Network Communication Report as an editable Microsoft Excel file.

1.7.2 Control System Inventory Report

{For Reference Only: This subpart (and its subparts) relates to CM-8(a), CP-12, SI-17, IA-3; CCI-000389, CCI-000392, CCI-000398, CCI-002855, CCI-002856, CCI-002857, CCI-002773, CCI-002774, CCI-002775, CCI-000777, CCI-000778, CCI-001958}

Provide a Control System Inventory report using the Inventory Spreadsheet listed under this Section at

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic> documenting all devices, including networked devices, network infrastructure devices, non-networked devices, input devices (e.g. sensors) and output devices (e.g. actuators). For each device provide all applicable information for which there is a field on the spreadsheet in accordance with the instructions on the spreadsheet.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Control System Inventory Report as an editable Microsoft Excel file.

1.7.3 Software Recovery and Reconstitution Images

{For Reference Only: This subpart (and its subparts) relates to CP-10; CCI-000550, CCI-000551, CCI-000552}

For each computer on which software is installed under this project, provide a recovery image of the final as-built computer. This image must allow for bare-metal restore such that restoration of the image is sufficient to restore system operation to the imaged state without the need for re-installation of software.

1.7.4 Cybersecurity Riser Diagram

{For Reference Only: This subpart (and its subparts) relates to PL-2(a); CCI-003051, CCI-003053}

Provide a cybersecurity riser diagram of the complete control system

including all network and controller hardware. If the control system specifications require a riser diagram submittal, provide a copy of that submittal as the cybersecurity riser diagram. Otherwise, provide a riser diagram in one-line format.

1.7.5 Control System Cybersecurity Documentation

This subpart (and its subparts) relates to SA-5 (a),(b),(c); CCIs: CCI-003124, CCI-003125, CCI-003126, CCI-003127, CCI-003128, CCI-003129, CCI-003130, CCI-003131}

Provide a Control System Cybersecurity Documentation submittal containing the indicated information for each device and software application.

1.7.5.1 Software Applications

For all software applications running on computers provide:

- a. administrator documentation that describes secure configuration of the software {relates to CCI-003124}
- b. administrator documentation that describes secure installation of the software {relates to CCI-003125}
- c. administrator documentation that describes secure operation of the software {relates to CCI-003124}
- d. administrator documentation that describes effective use and maintenance of security functions or mechanisms for the software {relates to CCI-003127}
- e. administrator documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the software {relates to CCI-003128}
- f. user documentation that describes user-accessible security functions or mechanisms in the software and how to effectively use those security functions or mechanisms {relates to CCI-003129}
- g. user documentation that describes methods for user interaction which enables individuals to use the software in a more secure manner {relates to CCI-003130}
- h. user documentation that describes user responsibilities in maintaining the security of the software {relates to CCI-003131}

1.7.5.2 For ESS System Devices

1.7.5.2.1 ESS System Devices FULLY Supporting User Accounts

For all ESS System Devices which FULLY support user accounts, provide:

- a. Documentation that describes secure configuration of the device {for reference only: relates to CCI-003124}
- b. Documentation that describes secure operation of the device {for reference only: relates to CCI-003124}
- c. Documentation that describes effective use and maintenance of security

functions or mechanisms for the device {for reference only: relates to CCI-003127}

- d. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {for reference only: relates to CCI-003128}
- e. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms; or a specific indication that there are no user-accessible security functions or mechanisms in the device {for reference only: relates to CCI-003129}
- f. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {for reference only: relates to CCI-003130}

1.7.5.2.2 All Other ESS Control System Devices

For all ESS Control System Devices which do not FULLY support user accounts, provide:

- a. Documentation that describes secure configuration of the device; or a specific indication that there are no secure configuration steps that apply {for reference only: relates to CCI-003124}
- b. Documentation that describes effective use and maintenance of security functions or mechanisms for the device; or a specific indication that there are no security functions or mechanisms in the device {for reference only: relates to CCI-003127}
- c. For devices which include a user interface, documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {for reference only: relates to CCI-003130}

1.7.5.3 Default Requirements for Control System Devices

For control system devices where Control System Cybersecurity Documentation requirements are not otherwise indicated in this Section, provide:

- a. Documentation that describes secure configuration of the device {for reference only: relates to CCI-003124}
- b. Documentation that describes secure installation of the device {for reference only: relates to CCI-003125}
- c. Documentation that describes secure operation of the device {for reference only: relates to CCI-003124}
- d. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {for reference only: relates to CCI-003127}
- e. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {for reference only: relates to CCI-003128}

- f. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms {for reference only: relates to CCI-003129}
- g. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {for reference only: relates to CCI-003130}
- h. Documentation that describes user responsibilities in maintaining the security of the device {for reference only: relates to CCI-003131}

1.8 SOFTWARE UPDATE LICENSING

{For Reference Only: This subpart (and its subparts) relates to SI-2 (a),(c); CCI-001227, CCI-002605}

In addition to all other licensing requirements, all software licensing must include licensing of the following software updates for a period of no less than 5 years:

- a. Security and bug-fix patches issued by the software manufacturer.
- b. Security patches to address any vulnerability identified in the National Vulnerability Database at <http://nvd.nist.gov> with a Common Vulnerability Scoring System (CVSS) severity rating of MEDIUM or higher.

Provide a single Software Licenses submittal with documentation of the software licenses for all software provided

1.9 CYBERSECURITY DURING CONSTRUCTION

{For Reference Only: This subpart (and its subparts) relates to AC-18, SA-3, CCI-00258}

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

1.9.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. When used, contractor computers must meet the following requirements:

1.9.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

1.9.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates, and must use the latest definitions file. All computers used on this project must be scanned using the installed software at least once per day.

1.9.1.3 Passwords and Passphrases

The passwords and passphrases for all computers must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.9.1.4 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using contractor owned computers. Contractor Computer Cybersecurity Compliance Statements must use the template published at <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic> Each Statement must be signed by a cybersecurity representative for the relevant company.

1.9.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks must meet the following requirements:

1.9.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than IP networks provided under this project or Government furnished IP networks provided for this purpose. Any and all network access from outside the project site is prohibited.

1.9.3 Government Access to Network

Government personnel must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification

1.9.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks must not interfere with existing wireless network and must use WPA2 security. Network names (SSID) for wireless networks must be changed from their default values.

1.9.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.9.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. Contractor Temporary Network Cybersecurity Compliance Statements must use the template published at <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic> Each Statement must be signed by a cybersecurity representative for the relevant company. If no temporary IP networks will be used, provide a

single copy of the Statement indicating this.

1.10 CYBERSECURITY DURING WARRANTY PERIOD

All work performed on the control system after acceptance must be performed using Government Furnished Equipment or equipment specifically and individually approved by the Government.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.1 ACCESS CONTROL REQUIREMENTS

3.1.1 User Accounts

{For Reference Only: This subpart (and its subparts) relate to AC-2(a) and AC-3; CCI-002110, CCI-000213.}

Any device supporting user accounts (either FULLY or MINIMALLY) must limit access to the device according to specified limitations for each account. Install and configure any device having a STIG or SRG in accordance with that STIG or SRG.

3.1.1.1 Computers

All computers must FULLY support user accounts.

3.1.1.2 For ESS Control System Devices

Devices with web interfaces must either FULLY support user accounts or have their web interface disabled. Field devices with full local user interfaces allowing modification of data must at least MINIMALLY support user accounts.

3.1.1.3 Default Requirements for Control System Devices

For control system devices where User Account requirements are not otherwise indicated in this Section:

- a. Devices with web interfaces must either FULLY support user accounts or have their web interface disabled.
- b. Field devices with full local user interfaces allowing modification of data must at least MINIMALLY support user accounts.
- c. Field devices with read-only full local user interfaces must at least MINIMALLY support user accounts.

3.1.2 Unsuccessful Logon Attempts

{For Reference Only: This subpart (and its subparts) relate AC-7 (a), AC-7 (b); CCI-000043, CCI-000044, CCI-001423, CCI-002236, CCI-002237, CCI-002238}

Except for high availability user interfaces indicated as exempt, devices

must meet the indicated requirements for handling unsuccessful logon attempts.

3.1.2.1 Devices MINIMALLY Supporting Accounts

Devices which MINIMALLY support accounts are not required to lock based on unsuccessful logon attempts.

3.1.2.2 Devices FULLY Supporting Accounts

Devices which FULLY support accounts must meet the following requirements. If a device cannot meet these requirements, document device capabilities to protect from subsequent unsuccessful logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures without explicit permission from the Government.

- a. It must lock the user account when three unsuccessful logon attempts occur within a 15 minute interval.
- b. Once an account is locked, the account must stay locked until unlocked by an administrator.
- c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.1.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

All interfaces for this control system are exempt from unsuccessful logon attempt requirements.

3.1.3 System Use Notification

{For Reference Only: This subpart (and its subparts) relates to AC-8; CCI-000048, CCI-002247, CCI-002243, CCI-002244, CCI-002245, CCI-002246, CCI-000050, CCI-002248}

Web interfaces must display a warning banner meeting the requirements of DTM 08-060.

Devices which are connected to a network and have a user interface must display a warning banner meeting the requirements of DTM 08-060 if capable of doing so. Devices which are connected to a network and have a user interface but are not capable of displaying a banner must have a permanently affixed label displaying an approved banner from DTM 08-060. Labels must be machine printed or engraved, plastic or metal, designed for permanent installation, must use a font no smaller than 14 point, and must provide a high contrast between font and background colors.

3.1.3.1 User Interface Banner Schedule

Provide a User Interface Schedule using the format indicated showing each user interface provided and how the information banner requirement has been implemented for each user interface.

User Interface Schedule Format (with sample entries)			
User Interface Description	User Interface Location	Type of User Interface	Banner Implementation
Sample 1	Room 1	Remote	DTM 08-060 Banner "A" Displayed at Logon
Sample 2	Room 2	Limited Local	DTM 08-060 Banner "B" on Affixed Label
Sample 3	Room 3	Full Local	DTM 08-060 Banner "B" Displayed on Screen

3.1.4 Permitted Actions Without Identification or Authentication

{For Reference Only: This subpart (and its subparts) relates to AC-14; CCI-000061, CCI-000232}

The control system must require identification and authentication before allowing any actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.

3.1.5 Wireless Access

{For Reference Only: This subpart (and its subparts) relates to AC-18; CCI-001438, CCI-001439, CCI-002323, CCI-001441}

Unless explicitly authorized by the Government, do not use any wireless communication. Any device with wireless communication capability is considered to be using wireless communication, regardless of whether or not the device is actively communicating wirelessly, except when wireless communication has been physically permanently disabled (such as through the removal of the wireless transceiver).

3.1.5.1 Wireless IP Communications

Do not install wireless IP networks, including: do not install a wireless access point; do not install or configure an ad-hoc wireless network; do not install or configure a WiFi Direct communication.

When explicitly authorized by the Government, wireless IP communication may be used to communicate with an existing wireless network.

3.1.5.2 Non-IP Wireless Communication

When non-IP wireless communication is explicitly authorized by the Government, use the maximum level of encryption supported by the specific protocol employed and select signal strength and radiated power to the minimum necessary for reliable communication.

3.1.5.3 Wireless Communication Request

Provide a report documenting the proposed use of wireless communication prior to beginning construction using the Wireless Communication Request

Schedule at

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic>

For each device proposed to use wireless communication show: the device identifier, a description of the device, the location of the device, the device identifiers of other devices communicating with the device, the protocol used for communication, encryption type and strength, RF Frequency, Radiated Power in dBm (decibel with a milliwatt reference), free-space range, and the expected as-installed range.

3.1.5.4 Wireless Communication Testing

As part of Performance Verification Testing (PVT), conduct testing of wireless communication for all devices indicated on the approved Wireless Communication Request as requiring testing.

To test wireless communication, test for wireless network reception at multiple points along the wireless test boundary in the vicinity of the wireless device, and record whether a network connection can be established at each point. The wireless test boundary is the facility fence line. If wireless testing is required, provide a Wireless Communication Test Report documenting the testing points and results at each point for each wireless device.

3.2 CYBERSECURITY AUDITING

3.2.1 Audit Events, Content of Audit Records, and Audit Generation

{For Reference Only: This subpart (and its subparts) relates to AU-2(a),(c),(d), AU-3, AU-12; CCI-000123, CCI-001571, CCI-000125, CCI-001485, CCI-000130, CCI-000131, CCI-000132, CCI-00133, CCI-000134, CCI-001487, CCI-000169, CCI-001459, CCI-000171, CCI-000172, CCI-001910}

For devices that have STIG/SRGs related to audit events, content of audit records or audit generation, comply with the requirements of those STIG/SRGs.

3.2.1.1 Computers

For each computer, provide the capability to select audited events and the content of audit logs. Configure computers to audit the indicated events, and to record the indicated information for each auditable event

3.2.1.1.1 Audited Events

Configure each computer to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)
- b. Successful and unsuccessful logon attempts
- c. Privileged activities or other system level access
- d. Starting and ending time for user access to the system
- e. Concurrent logons from different workstations

- f. Successful and unsuccessful accesses to objects
- g. All program initiations
- h. All direct access to the information system
- i. All account creations, modifications, disabling, and terminations
- j. All kernel module load, unload, and restart

3.2.1.1.2 Audit Event Information To Record

Configure each computer to record, for each auditable event, the following information (where applicable to the event):

- a. What type of event occurred
- b. When the event occurred
- c. Where the event occurred
- d. The source of the event
- e. The outcome of the event
- f. The identity of any individuals or subjects associated with the event

3.2.1.2 For ESS Control System Devices

3.2.1.2.1 ESS Control System Devices FULLY Supporting User Accounts

For devices FULLY supporting accounts, provide the capability to select audited events, and the contents of audit logs. Configure devices to audit the following events:

- a. Successful and unsuccessful logon attempts to the device
- b. Starting and ending time for user access to the device
- c. All account creations, modifications, disabling, and terminations
- d. All device shutdown and startup

Configure the device to record for each event the following information (as applicable): the type of event, when the event occurred and the identity of any individuals or subjects associated with the event

3.2.1.2.2 Other ESS Control System Devices

There are no requirements to perform auditing at ESS field devices that do not FULLY support accounts.

3.2.1.3 Default Requirements for Control System Devices

For control system devices where Audit Events, Content of Audit Records, and Audit Generation are not otherwise indicated in this Section:

3.2.1.3.1 Devices Which FULLY Support Accounts

For each device which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure devices to audit the indicated events, and to record the indicated information for each auditable event

3.2.1.3.1.1 Audited Events

Configure each device to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)
- b. Successful and unsuccessful logon attempts
- c. Privileged activities or other system level access
- d. Starting and ending time for user access to the system
- e. Concurrent logons from different workstations
- f. All account creations, modifications, disabling, and terminations
- g. All kernel module load, unload, and restart

3.2.1.3.1.2 Audit Event Information To Record

Configure each computer to record, for each auditable event, the following information (where applicable to the event):

- a. what type of event occurred
- b. when the event occurred
- c. where the event occurred
- d. the source of the event
- e. the outcome of the event
- f. the identity of any individuals or subjects associated with the event

3.2.1.3.2 Devices Which Do Not FULLY Support Accounts

For each Device which does not FULLY support accounts configure the device to audit all device shutdown and startup events and to record for each event the type of event and when the event occurred.

3.2.2 Audit Storage Capacity and Audit Upload

{For Reference Only: This subpart (and its subparts) relates to AU-4; CCI-001848, CCI-001849}

- a. For devices that have STIG/SGRs related to audit storage capacity (CCI-001848 or CCI-001849) comply with the requirements of those STIG/SGRs.

- b. For non-computer control system devices capable of generating audit records, provide 60 days worth of secure local storage, assuming 10 auditable events per day.

3.2.2.1 Device Audit Record Upload Software

For each non-computer device required to audit events, provide, and license to the Government, software implementing a secure mechanism of uploading audit records from the device to a computer and of exporting the uploaded audit records as a Microsoft Excel file. Where different devices use different software, provide software of each type required to upload audit logs from all devices.

Submit copies of device audit record upload software. If there are no non-computer devices requiring auditing, provide a document stating this in lieu of this submittal.

3.2.3 Time Stamps

{For Reference Only: This subpart (and its subparts) relates to AU-8; CCI-000159, CCI-001889, CCI-001890}

3.2.3.1 Default Requirements for Control System Devices

For control system devices where Time Stamps requirements are not otherwise indicated in this Section: Devices generating audit records must have internal clocks capable of providing time with a resolution of 1 second. Clocks must not drift more than 10 seconds per day. Configure the system so that each device generating audit records maintains accurate time to within 1 second.

3.3 REQUIREMENTS FOR LEAST FUNCTIONALITY

{For Reference Only: This subpart (and its subparts), along with the network communication report submittal specified elsewhere in this section, relates to CM-6 (a), (c), CM-7, CM-7 (1)(b), SC-41; CCI-000363, CCI-000364, CCI-000365, CCI-001588, CCI-001755, CCI-000381, CCI-000380, CCI-00382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546.}

For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I/O access for least functionality), install and configure the device in accordance with that STIG or SRGs.

For ESS Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

For Other Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

3.3.1 Non-IP Control Networks

When control system specifications require particular communication protocols, use only those communication protocols and only as specified. Do not implement any other communication protocol, or use any protocol on ports other than those specified.

When control system specifications do not indicate requirements for communication protocols, use only those protocols required for operation of the system as specified.

3.3.2 IP Control Networks

Do not use nonsecure functions, ports, protocols and services as defined in DODI 8551.01 unless those ports, protocols and services are specifically required by the control system specifications or otherwise specifically authorized by the Government. Do not use ports, protocols and services that are not specified in the control system specifications or required for operation of the control system.

3.4 SAFE MODE AND FAIL SAFE OPERATION

{For Reference Only: This subpart (and its subparts) relates to CP-12, SI-17; CCI-002855, CCI-002856, CCI-002857, CCI-002773, CCI-002774, CCI-002775}

For all control system components with an applicable STIG or SRG, configure the component in accordance with all applicable STIGs and SRGs.

3.5 IDENTIFICATION AND AUTHENTICATION

3.5.1 User Identification and Authentication

{For Reference Only: This subpart (and its subparts) relates to IA-2,(1),(12); CCI-000764, CCI-000765, CCI-001953, CCI-001954}

- a. Devices that FULLY support accounts must uniquely identify and authenticate organizational users.
- b. Devices which allow network access to privileged accounts must implement multifactor authentication for network access to privileged accounts.

3.5.1.1 ESS Control Systems Devices

Identification and Authentication for network access to privileged accounts must be implemented by either accepting and electronically verify Personal Identity Verification (PIV) credentials or inheriting identification and authentication from the operating system.

3.5.1.2 Default Requirements for Control System Devices

For control system devices where User Identification and Authentication requirements are not otherwise indicated in this Section, User Identification and Authentication for network access to privileged accounts must be implemented by accepting and electronically verify Personal Identity Verification (PIV) credentials.

3.5.2 Authenticator Management

{For Reference Only: This subpart (and its subparts) relates to IA-5 (b),(c),(e),(g),(1),(11); CCI-000176, CCI-001544, CCI-001989, CCI-000182, CCI-001610, CCI-000192, CCI-000193, CCI-000194, CCI-000205, CCI-001619, CCI-001611, CCI-001612, CCI-001613, CCI-001614, CCI-000195, CCI-001615, CCI-000196, CCI-000197, CCI-000199, CCI-000198, CCI-001616, CCI-001617, CCI-000200, CCI-001618, CCI-002041, CCI-002002, CCI-002003}

3.5.2.1 Authentication Type

3.5.2.1.1 For ESS Control System Devices

Unless otherwise indicated:

- a. Software which FULLY supports accounts and which runs on a computer must use password-based authentication or hardware token-based authentication.
- b. Other devices which FULLY support accounts must use password-based authentication.
- c. Devices MINIMALLY supporting accounts must use password-based authentication.

3.5.2.1.2 Default Requirements for Control System Devices

For control system devices where Authentication Type requirements are not otherwise indicated in this Section:

- a. Software which FULLY supports accounts and which runs on a computer must use password-based authentication or hardware token-based authentication.
- b. Other devices which FULLY support accounts must use either password-based authentication or hardware token-based authentication.
- c. Devices MINIMALLY supporting accounts must use either password-based authentication or hardware token-based authentication.

3.5.2.2 Password-Based Authentication Requirements

3.5.2.2.1 Passwords for Computers

All computers supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character.
- f. Password must have a minimum lifetime of 24 hours.
- g. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- h. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters.
- i. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.2 Passwords for Non-Computer Devices FULLY Supporting Accounts

All non-computer devices FULLY supporting accounts and supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of twelve (12) characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character.
- f. Password must have a maximum lifetime of sixty (60) days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five (5) passwords, where differ is defined as changing at least fifty percent of the characters.
- h. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.3 Passwords for Web Interfaces

Passwords for connecting to a web interface supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character.
- f. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters.
- h. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.4 Passwords for Devices Minimally Supporting Accounts

Devices minimally supporting accounts must support passwords with a minimum length of four characters.

3.5.2.2.5 Password Configuration and Reporting

For all devices with a password, change the password from the default password. Do not use the same password for more than one device unless

specifically instructed to do so. Provide a Password Summary Report documenting the password for each device and describing the procedure to change the password for each device.

Do not provide the Password Summary Report in electronic format. Provide two hardcopies of the Password Summary Report, each copy in its own sealed envelope.

3.5.2.3 Hardware Token-Based Authentication Requirements

Devices supporting hardware token-based authentication must use Personal Identity Verification (PIV) credentials for the hardware token.

3.5.3 Authenticator Feedback

{For Reference Only: This subpart relates to IA-6; CCI-000206}

Devices must never show authentication information, including passwords, on a display. Devices that momentarily display a character as it is entered, and then obscure the character, are acceptable. For devices that have STIGs or SRGs related to obscuring of authenticator feedback (CCI-000206), comply with the requirements of those STIGS/SRGs.

3.6 EMERGENCY POWER

{For Reference Only: This subpart (and its subparts) relates to PE-11,(1); CCI-02955, CCI-000961}

Emergency power is specified in the control system and equipment specifications.

3.7 DURABILITY TO VULNERABILITY SCANNING

{For Reference Only: This subpart (and its subparts) relates to RA-5 (a),(b),(c),(d); CCI-001054, CCI-001055, CCI-0010156, CCI-001641, CCI-001643, CCI-001057, CCI-001058, CCI-001059}

All IP devices must be scannable, such that the device can be scanned by industry standard IP network scanning utilities without harm to the device, application, or functionality.

3.7.1 ESS Control System Devices Other Than Computers

ESS control system devices other than computers are not required to respond to scans.

3.7.2 Default Requirements for Control System Devices

Non-computer control system devices where Durability to Vulnerability are not required to respond to scans.

3.8 SYSTEM AND INTEGRATION INTEGRITY

3.8.1 Malicious Code Protection

{For Reference Only: This subpart (and its subparts) relates to SI-3(c); CCI-001241, CCI-002623}

For all computers installed under this project, install and configure

malware protection software in accordance with the relevant STIGs.

3.9 FIELD QUALITY CONTROL

3.9.1 Tests

In addition to testing and testing support required by other Sections, provide a minimum of 4 hours of technical support for cybersecurity testing of control systems.

-- End of Section --

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SECTION 26 05 33

DOCKSIDE POWER CONNECTION STATIONS

01/07, CHG 1: 11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1 ((2014; Errata 2016) Electric Meters -
Code for Electricity Metering

ASTM INTERNATIONAL (ASTM)

ASTM A167 (2011) Standard Specification for
Stainless and Heat-Resisting
Chromium-Nickel Steel Plate, Sheet, and
Strip

ASTM D709 (2017) Standard Specification for
Laminated Thermosetting Materials

ASTM D1535 (2014; R 2018) Standard Practice for
Specifying Color by the Munsell System

ASTM D2240 (2015; E 2017) Standard Test Method for
Rubber Property - Durometer Hardness

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative
Dictionary of IEEE Standards Terms

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

IEEE C57.12.28 (2014) Standard for Pad-Mounted Equipment
- Enclosure Integrity

IEEE C57.13 (2016) Requirements for Instrument
Transformers

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2017; Errata 2017) Standard for
Acceptance Testing Specifications for
Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.7 (2014) Requirements for Watthour Meter
Sockets

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-24368/2 (1987; Rev B; Notice 1 2020) Connector Assemblies; Receptacle, and Receptacle-Cabled, Power Transfer, Shore to Ship and Ship to Ship, 500 Volts, 500 Amperes, 60 Hertz, Symbol Number 1161

MIL-DTL-24643/3 (2009; Rev E) Cable, Electrical, -20 Degrees C to +90 Degrees, 600 Volts, Types LSSHOF, LSDHOF, LSTHOF, and LSFHOF

UNDERWRITERS LABORATORIES (UL)

UL 50 (2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations

UL 94 (2013; Reprint Jun 2020) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 489 (2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

600 V Power Connection Station; G

Ship Service Emergency Trip Panel; G

Include wiring diagrams and installation details of equipment

indicating layout and arrangement, control panels, accessories, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

SD-03 Product Data

600 V Single Pole Connectors; G

Industrial Service Auxiliary Devices; G

Metering Accessories; G

SD-06 Test Reports

Paint Coating System; G

600 V Single Pole Connector Compatibility Tests; G

600 V Single Pole Connector Torque Test; G

Acceptance Checks and Tests; G

SD-10 Operation and Maintenance Data

600 V Power Connection Station, data package 5; G

Ship Service Emergency Trip Panel; G

1.5 QUALITY ASSURANCE

1.5.1 Drawings

Furnish drawings that include, but are not limited to, the following:

- a. One-line diagram including breakers, fuses, current transformers, and meters.
- b. Outline drawings including front elevation, section views, footprint, and overall dimensions.
- c. Markings and NEMA nameplate data, including fuse information (manufacturer's name, catalog number, and ratings).
- d. Circuit breaker type, interrupting rating, and trip devices, including available settings.
- e. Three-line diagrams and elementary diagrams and wiring diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.
- f. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and

largest secondary feeder device. These shall be used by the designer of record to provide breaker settings that will insure protection and coordination are achieved.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer and the component parts of the item shall be the products of the same manufacturer.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7 MAINTENANCE

1.7.1 Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 600 V POWER CONNECTION STATION

Ship service and industrial service power connection station assemblies shall include enclosure, power receptacles, auxiliary devices, metering accessories, and related wiring. Each power connection station shall have the number of circuits indicated and each circuit shall provide three-phase, three-wire service.

2.1.1 Enclosure Integrity

Enclosure shall be UL 50 listed, type 3R, fabricated entirely of ASTM A167 type 304 or 304L stainless steel. All interior and exterior covers and doors shall be minimum 12 gauge stainless steel sheets. Unit shall have fixed top and open bottom. Side covers shall be bolt-on and removable. Rear covers shall be hinged. Optional doors shall have full height continuous hinge and door stop to allow door to be secured open at 90 degrees. Ventilating or similar openings in equipment shall be designed so that foreign objects inserted through these openings are deflected from energized parts. Paint enclosure ASTM D1535 light gray No. 61. Paint coating system shall comply with IEEE C57.12.28.

2.1.2 600 V Single Pole Connectors

Insulated connectors shall be rated for 600 volts, 690 amperes, 60 hertz, single pole, continuous duty operation. Connectors shall be compatible with Leviton and Duraline cam-type positive latching ball nose connectors. Insulation and protective caps shall be ethylene propylene thermoplastic rubber (EPTR) colored black phase A, white phase B, and red phase C, conforming to the following:

- a. Constant Service Temperature Range: minus 81 degrees F to 275 degrees F
- b. Flammability: UL 94 HB Rated
- c. Electrical: UL Relative Thermal Index (RTI): 212 degrees F) minimum
- d. Durometer Hardness: ASTM D2240, 55 - 65A

2.1.2.1 Panel Mount Connectors

Provide 15 degree angled, panel mount female connectors (receptacles) with threaded stud terminations. Each receptacle shall be provided with a protective cap attached via wirelon. Panel Mount Connectors (receptacles) indicated to have electric interlock switches shall have a thru-center plunger that engages a single-pole double-throw, water-tight aluminum housed "roller lever actuated" switch upon insertion of a connector plug. UL listed switch shall be electrically rated for 100,000 cycles at 10 amps, 125/250 VAC, and mechanically rated for 20,000,000 cycles.

2.1.2.2 Cable Mount In-Line Connectors

Male and female cable mount in-line connectors (plugs) shall be designed for terminating on 500 kcmil cables with a crimp-type connection. The connectors shall lock together so that they can not twist or turn loose unless a push button release mechanism is engaged. The insulated sleeve shall be mechanically secured to the connector contacts to give a minimum of 700 pounds shear force. Provide a mating male cable mount in-line

connector (plug) for each panel mount connector to be turned over to the contracting officer.

2.1.1.3 600 V Power Receptacle

Rated for 500 volts, 500 amperes, 60 hertz, three-pole, continuous duty operation. Power receptacle assembly shall conform to MIL-C-24368/2. Provide receptacle assembly with factory potted cable pigtails. Cable pigtails shall be a minimum of 4 feet in length and 3-1/c Type LSSHOF-500 cables conforming to MIL-DTL-24643/3. Provide each receptacle with provisions for interlocking the receptacle with its respective feeder circuit breaker so that breaker will trip automatically if an attempt is made to remove the plug from the receptacle and when the receptacle cover is opened.

2.1.1.4 Industrial Service Auxiliary Devices

Provide the following auxiliary devices for each industrial service power connection station circuit.

2.1.1.4.1 Shunt Trip Pushbutton Control

Provide NEMA Q600 rated, 30 millimeter, heavy duty industrial type, normally-open, momentary, red pushbutton behind a spring return cover, each circuited to shunt trip one circuit breaker.

2.1.1.4.2 Fusing

Provide a fuse block mounted in the enclosure containing one fuse per phase to protect the voltage input to the watt hour meter and circuit breaker shunt trip.

2.1.1.4.3 Circuit Breaker

UL 489. 100 percent rated, non-fused, current limiting, molded case circuit breaker, 480 VAC, 400 amperes, 3-pole, 200 kaic short circuit current interrupting rating, with a 480 V shunt trip.

2.1.1.4.4 Circuit Breaker Operating Mechanism

Provide flexible cable mechanism with flange mounted disconnect handle for each circuit breaker as indicated.

2.1.1.5 Metering Accessories

Provide watt-hour meter and current transformers for each industrial service power connection station circuit.

2.1.1.5.1 Watt-hour Meter

Provide a socket-mounted, electronic programmable outdoor watt-hour meter mounted on door of cabinet. Meter shall either be programmed at the factory or shall be programmed in the field. When field programming is performed, turn field programming device over to the Contracting Officer at completion of project. Meter shall be coordinated to system requirements and conform to ANSI C12.1.

- a. Design: Provide watt-hour meter for use on a three-phase, 3-wire, 480 volt system with 3 current transformers. Include necessary KYZ pulse

initiation hardware for Energy Monitoring and Control System (EMCS).

- b. Class: 20; Form: 45S, accuracy: plus or minus 1.0 percent; Finish: Class II
- c. Cover: Polycarbonate and lockable to prevent tampering and unauthorized removal.
- d. Kilowatt-hour Register: Five digit electronic programmable type
- e. Demand Register:
 - 1. Provide solid state.
 - 2. Meter reading multiplier: Indicate multiplier on the meter face.
 - 3. Demand interval length: Shall be programmed for 15 minutes with rolling demand up to six subintervals per interval.
- f. Socket: ANSI C12.7. Provide NEMA Type 3R stainless steel, box-mounted socket, ringless, having manual circuit-closing bypass and having jaws compatible with requirements of the meter. Cover unused hub openings with blank hub plates. Provide manufacturers standard enclosure color unless otherwise indicated.

2.1.5.2 Current Transformers

IEEE C57.13. Provide butyl-molded window type current transformers with 600 volt insulation, 10 kV BIL. Provide three current transformers with characteristics listed in the following table.

<u>CT Ratio</u>	<u>RF</u>	<u>Meter Accuracy Class</u>
400/5	4.0	0.3 thru B-0.2

2.1.6 Enclosure Configurations

- a. Enclosures for ship service stations shall be configured as indicated. All three receptacles of the same circuit shall be mounted on a common plate. Each plate shall have handles on both ends and shall be bolted to the front cover so that it can be removed from the front without disconnecting the incoming circuit power cables. Each section shall include a full width ground bus. Each section shall have a hinged pad lockable door. Provide nameplates to identify each phase designation and each circuit number as indicated.
- b. Enclosures for industrial service stations shall be configured as indicated. All three receptacles of the same circuit shall be mounted on a common plate. Each plate shall have handles on both ends and shall be bolted to the front cover so that it can be removed from the front without disconnecting the power cable. Include a full width internal ground bus and a ground bus with four NEMA spaced lug mounting holes on the exterior as indicated. Mount the circuit breakers, and current transformers on inside of enclosure. The handle for the circuit breaker operating mechanism shall be located on the

rear flange. Mount watt-hour meters on side covers. Mount shunt trip pushbuttons on rear as indicated.

2.2 ENCLOSURE HEATERS

Provide 120-volt heaters in each enclosure. Heaters shall be of sufficient capacity to control moisture condensation in the compartments, shall be 250 watts minimum when operated at 120V, and shall be controlled by a thermostat and humidistat located in each enclosure. Thermostat shall be industrial type, high limit, to maintain compartments within the range of 60 to 90 degrees F. Humidistat shall have a range of 30 to 60 percent relative humidity. Energize electric heaters while the equipment is in storage or in place prior to being placed in service. Provide method for easy connection of heater to external power source. Provide control power transformer connected ahead of local metering.

2.3 SHIP SERVICE EMERGENCY TRIP PANEL

Provide a stainless steel NEMA 3R cabinet sized as necessary with a color red pushbutton cover mounted behind the front door. Pushbutton shall be rated for 10 amperes continuous at 600 volts, heavy duty, watertight, momentary contact, marked "SHIP SERVICE EMERGENCY TRIP".

2.4 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.5 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.6 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background.

2.7 SOURCE QUALITY CONTROL

2.7.1 Paint Coating System

Submit IEEE C57.12.28 paint coating system performance requirement tests.

2.7.2 600 V Single Pole Connector Compatibility Tests

Conduct the following tests in the sequence noted on a male in-line connector mated with a Leviton or Duraline female in-line connector and a female in-line connector mated with a Leviton or Duraline male in-line connector with each connector terminated on a bare 500 kcmil copper conductor. After completion of the tests, inspect assemblies. There shall be no evidence of damage to the connectors. Assemblies shall be satisfactory for immediate return to service at full ratings without maintenance or repair. Contracting Officer or his designated representative will witness the tests.

2.7.2.1 Impact Test

Drop each mated connector set in a horizontal position from a height of 36-inches onto a concrete floor 50 times.

2.7.2.2 Pull Strain Test

Apply a 500-lb straight pull on each mated connector set for a duration of 5-minutes.

2.7.2.3 Shear Test

Apply a 100-lb perpendicular pull on each mated connector set for a duration of 5-minutes.

2.7.2.4 Torque Test

Apply a 100 ft-lb torque on each mated connector set for a duration of 5-minutes.

2.7.2.5 Heat Rise Test

Apply 400 amperes through each mated connector set for duration of 30-minutes. Record temperature rise at surface of each mated connector set via infrared scanning equipment. Temperature rise shall be less than 45 degree C.

2.7.2.6 Moisture Resistance Test

Subject the mated connectors to a water spray maintained at 5-psi, with a collection rate of 18-in/hr, at a distance of 5-feet, for one hour. Verify that no water penetrated the connection.

2.7.2.7 Dielectric Voltage Withstand Test

Wrap the mated connectors in conductive foil and apply a test potential of 2200 VAC between the conductor and the foil for a period of 5-minutes. Dielectric breakdown shall constitute a failed test.

2.7.2.8 Insulation Resistance Test

Wrap the mated connectors in conductive foil and using a Megger insulation resistance tester with an open circuit output of 500 VDC, measure the insulation resistance between the conductor and foil. Resistance measurement shall be greater than 100 Megohms.

2.7.3 600 V Single Pole Connector Torque Test

Conduct a torque test on three male and three female cable mount in-line connectors as follows: With the metal connector part rigidly secured, apply a rotating (twisting) force of 700 lbs on the insulating sleeve. The insulating sleeve shall not break free and spin around the connector metal part. Contracting Officer or his designated representative will witness the tests.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.2 POWER CONNECTION STATION GROUNDING

Ground in accordance with NFPA 70. Maximum resistance from assembly to ground shall be 3 ohms.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.6 FIELD QUALITY CONTROL

3.6.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.6.1.1 Power Connection Stations and Control Panels

- a. Visual and mechanical inspection performed in accordance with inspection and test procedures for Switchgear and Switchboard Assemblies.

- b. System function tests.

3.6.1.2 Current Transformers

- a. Visual and mechanical inspection in accordance with inspection and test procedures for Instrument Transformers.
- b. Electrical tests in accordance with inspection and test procedures for Instrument Transformers.

3.6.1.3 Watt-hour Meters

- a. Visual and mechanical inspection in accordance with inspection and test procedures for Metering Devices.
- b. Electrical tests in accordance with inspection and test procedures for Metering Devices.

3.6.1.4 Circuit Breakers

- a. Visual and mechanical inspection in accordance with inspection and test procedures for Circuit Breakers, Air, Insulated-Case/Molded-Case.
- b. Perform Electrical tests in accordance with inspection and test procedures for Circuit Breakers, Air, Insulated-Case/Molded-Case.

3.7 DEMONSTRATION

Upon completion of the work and at a time approved by the Contracting Officer, the Contractor shall provide instructions by a qualified instructor to the Government personnel in the proper operation and maintenance of the equipment. Government personnel shall receive training comparable to the equipment manufacturer's factory training. The duration of instruction shall be for not less than one 8 hour working day for instruction of operating and maintenance personnel.

3.8 Special Testing for Seismic-Resisting Equipment

Equipment is required to remain operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise. Seismic component qualification documentation for each piece of equipment must contain the information required in UFC 3-301-02, Section 2-17.2.5 Component Qualification Documentation. Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be less than 5 inches by 7 inches with red letters 1-inch in height on a white background stating "Certified Equipment". The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file". The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

3.9 Special Inspection for Seismic-Resisting Systems and Equipment

Perform special inspections for seismic-resisting systems, equipment and components for structures assigned to Risk Category IV per Section 01 45 35 SPECIAL INSPECTIONS.

-- End of Section --

SECTION 26 05 48.00 10

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT
10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2017) Steel Construction Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2019) Structural Engineering

UFC 3-301-02 (2020) Design of Risk Category V
Structures, National Strategic Military
Assets

UNDERWRITERS LABORATORIES (UL)

UL 1598 (2021; Reprint Jun 2021) Luminaires

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below that are installed on the Pier. Structural requirements shall be in accordance with Section 13 48 73 SEISMIC CONTROL FOR MECHANICAL EQUIPMENT.

1.2.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Light Fixtures and Poles	Primary, Transformer, Secondary Switchboards / Switchgear, and Meters
600V Power Connection Stations	Conduits
Control Panels	Outdoor Telecommunications Enclosures

1.2.3 Electrical Systems

The following electrical systems shall be installed as required on the

drawings and other sections of these specifications and shall be seismically protected in accordance with this specification: all Pier electrical equipment.

1.2.4 Contractor Designed Bracing

Submit copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design the bracing in accordance with UFC 3-301-01 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. UFC 3-301-01 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using UFC 3-301-01 are based on strength design; therefore, AISC 325 shall be used for the design. Develop the bracing for the following electrical equipment and systems:

Light Fixtures and Poles
Unit Substation (Primary, Transformer, Secondary Switchboards /
Switchgear, and Meters)
Meters
600V Power Connection Stations
Conduits
Outdoor Telecommunications Enclosures

1.2.5 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 2-1/2 inches trade size. All other interior conduit, shall be seismically protected as specified.

1.3 EQUIPMENT REQUIREMENTS

Submit detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail, indicating thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. Submit copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.3.1 Rigidly Mounted Equipment

The following specific items of equipment: Equipment listed in 1.2.2 to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-301-01. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting Fixtures and Poles
Equipment Requirements

SD-03 Product Data

Lighting Fixtures and Poles; G
Equipment Requirements; G
Contractor Designed Bracing; G

PART 2 PRODUCTS

2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to UL 1598.

2.2 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13 48 73 SEISMIC CONTROL FOR MECHANICAL EQUIPMENT.

PART 3 EXECUTION

3.1 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe in accordance with Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT.

3.2 LIGHTING FIXTURES IN BUILDINGS

3.2.1 Lateral Force

Structural requirements for light fixture bracing shall be in accordance with Section 13 48 73 SEISMIC CONTROL FOR MECHANICAL EQUIPMENT.

3.3 SPECIAL TESTING FOR SEISMIC-RESISTING EQUIPMENT

Equipment and components designated as Designated Seismic Systems required to remain operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise. Seismic component qualification documentation for each piece of equipment must contain the information required in UFC 3-301-02, Section 2-17.2.5 Component Qualification Documentation. Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be

less than 5 inches x 7 inches with red letters 1 inch in height on a white background stating "Certified Equipment." The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file." The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

3.4 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS AND EQUIPMENT

Perform special inspections for seismic-resisting systems, equipment and components for structures assigned to Risk Category V; designated seismic systems and equipment per ICC IBC 1705.12.4; and storage racks per ICC IBC 1705.12.7. Periodic special inspections will be conducted on miscellaneous equipment as required by Section 1705.12 of the International Building Code and paragraph 2-2.4.3 of UFC 3-301-01. Provide a Statement of Special Inspections and Final Report in accordance with paragraph 2-2.4.3 of UFC 3-301-01.

-- End of Section --

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING

08/08, CHG 1: 02/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
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1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Acceptance tests and inspections; G

SD-07 Certificates

Qualifications of organization, and lead engineering technician; G

Acceptance test and inspections procedure; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

- a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments

used shall be calibrated in accordance with NETA ATS.

- b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

- a. Section 26 32 15.00 ENGINE-GENERATOR SET STATIONARY 15-2500 KW, WITH AUXILIARIES. Functional engine shutdown tests, vibration base-line test, and load bank test shall not be performed by the testing organization. These tests shall be performed by the start-up engineer.
- b. Section 11 11 37 ELECTRIC VEHICLE SUPPLY EQUIPMENT
- c. Section 26 12 19.10 THREE-PHASE, LIQUID-FILLED PAD-MOUNTED TRANSFORMERS

- d. Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Medium voltage cables and grounding systems only.
- e. Section 26 13 00 SF6/HIGH-FIREPOINT FLUID INSULATED PAD-MOUNTED SWITCHGEAR
- f. Section 26 11 16 SECONDARY UNIT SUBSTATIONS
- g. Section 26 36 23 AUTOMATIC TRANSFER SWITCHES AND BY-PASS/ISOLATION SWITCH
- h. Section 26 23 00 LOW VOLTAGE SWITCHGEAR
- i. Section 26 24 13 SWITCHBOARDS

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

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SECTION 26 11 16

SECONDARY UNIT SUBSTATIONS

02/10, CHG 2: 11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|----------------|---|
| ANSI C12.1 | ((2014; Errata 2016) Electric Meters -
Code for Electricity Metering |
| ANSI C39.1 | (1981; R 1992) Requirements for Electrical
Analog Indicating Instruments |
| ANSI C57.12.13 | (1982) Conformance Requirements for
Liquid-Filled Transformers |

ASTM INTERNATIONAL (ASTM)

- | | |
|-----------------|---|
| ASTM A167 | (2011) Standard Specification for
Stainless and Heat-Resisting
Chromium-Nickel Steel Plate, Sheet, and
Strip |
| ASTM D92 | (2012a) Standard Test Method for Flash and
Fire Points by Cleveland Open Cup Tester |
| ASTM D97 | (2017b) Standard Test Method for Pour
Point of Petroleum Products |
| ASTM D709 | (2017) Standard Specification for
Laminated Thermosetting Materials |
| ASTM D877/D877M | (2019) Standard Test Method for Dielectric
Breakdown Voltage of Insulating Liquids
Using Disk Electrodes |
| ASTM D1535 | (2014; R 2018) Standard Practice for
Specifying Color by the Munsell System |

FM GLOBAL (FM)

- | | |
|--------------|---|
| FM APP GUIDE | (updated on-line) Approval Guide
http://www.approvalguide.com/ |
|--------------|---|

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- | | |
|----------|--|
| IEEE 100 | (2000; Archived) The Authoritative
Dictionary of IEEE Standards Terms |
| IEEE 386 | (2016) Separable Insulated Connector |

Systems for Power Distribution Systems
Rated 2.5 kV through 35 kV

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C37.20.3	(2013) Standard for Metal-Enclosed Interrupter Switchgear
IEEE C37.90.1	(2013) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C37.121	(2012) American National Standard for Switchgear-Unit Substations - Requirements
IEEE C57.12.00	(2015) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE C57.12.80	(2010) Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	(2015; Corr 2017) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(2016) Requirements for Instrument Transformers
IEEE C57.98	(2011) Guide for Transformer Impulse Tests
IEEE C62.11	(2020) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA LI 1	(1998; R 2011) Industrial Laminating Thermosetting Products
NEMA ST 20	(2014) Dry-Type Transformers for General Applications
NEMA/ANSI C12.10	(2011) Physical Aspects of Watthour Meters

- Safety Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203 (1992) Fish Acute Toxicity Test

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 712-C-98-075 (1998) Fate, Transport and Transformation
Test Guidelines - OPPTS 835.3100- "Aerobic
Aquatic Biodegradation"

EPA 821-R-02-012 (2002) Methods for Measuring the Acute
Toxicity of Effluents and Receiving Waters
to Freshwater and Marine Organisms

UNDERWRITERS LABORATORIES (UL)

UL 467 (2013; Reprint Jun 2017) UL Standard for
Safety Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section,
with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms
used in these specifications, and on the drawings, shall be as defined in
IEEE 100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S"
classification. Submittals not having a "G" or "S" classification are for
Contractor Quality Control approval. Submit the following in accordance
with Section 01 33 00 SUBMITTAL PROCEDURES:

As an exception to the transformer submittal requirements specified
herein, liquid-filled transformers manufactured by ABB in South Boston,
VA; by Cooper Power Systems in Waukesha, WI; or by Howard Industries in
Laurel, MS need not meet the submittal requirements of this contract.
Instead, the following shall be submitted:

- a. A certification, from the manufacturer, that the technical
requirements of this specification shall be met.
- b. An outline drawing of the transformer with devices identified
(paragraph entitled "Transformer Drawings," item a).
- c. ANSI nameplate data of the transformer (paragraph entitled
"Transformer Drawings", item b).

- d. Routine and other tests (paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and will be witnessed by the government (paragraph entitled "Source Quality Control"). Provide transformer test schedule required by submittal item "SD-11 Closeout Submittals". Provide certified copies of the tests.
- e. Provide acceptance test reports required by submittal item "SD-06 Test Reports".
- f. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

1.4.1 Coordinated Submittal Reviews

- a. Submit remaining substation component submittals to Engineer of Record for approval. In addition, submit one set of transformer submittals for surveillance and to insure alignment of equipment and coordination for interconnections.

SD-02 Shop Drawings

Unit Substation Drawings; G

Transformer drawings; G

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

SD-03 Product Data

Fuse curves; G

Secondary unit substation excluding transformer data; G

Unit substation transformer (liquid-filled)); G

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

SD-06 Test Reports

Acceptance checks and tests; G

SD-07 Certificates

Paint coating system; G

Transformer Losses; G

SD-09 Manufacturer's Field Reports

Load Interrupter Switch production tests; G

Unit substation transformer design tests (liquid-filled) (to code CI44074); G

Unit substation transformer routine and other tests (liquid-filled) (to code CI44074); G

SD-10 Operation and Maintenance Data

Unit substations, Data Package 5; G

SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals; G

Equipment test schedule (to Code CI44 for liquid-filled units); G

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

1.5.1.1 Unit Substation Drawings

Drawings shall include, but are not limited to the following:

- a. An outline drawing, with front, top, and side views showing incoming, transformer, and outgoing sections. Include switchgear information from Section 26 23 00 LOW VOLTAGE SWITCHGEAR as part of the total unit substation.
- b. One-line diagram showing fused load interrupter switch, current transformers, meters, and ampere rating of bus bars.
- c. Elementary diagrams and wiring diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.
- d. Time-current characteristic fuse curves (on full size logarithmic paper) for the load interrupter switch fuse.

1.5.1.2 Transformer Drawings

Drawings shall include, but are not limited to the following:

- a. An outline drawing, with front, top, and side views.
- b. ANSI nameplate data.

1.5.2 Paint Coating System

Submit IEEE C57.12.29 coating system performance requirement tests. When interrupter switchgear and transformer are provided by two different manufacturers, each one shall provide certification.

1.5.3 Transformer Losses

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses".

1.5.4 Substation Product Data

Submittal shall include manufacturer's information for each component, device, and accessory provided with the equipment.

1.5.5 Test Reports

Submit report of acceptance test results as specified by paragraph entitled "Field Quality Control."

1.5.6 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.7 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.7.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.7.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 MAINTENANCE

1.6.1 Assembled Operation and Maintenance Manuals

Manuals shall be assembled in durable, hard covered, water resistant binders. The manual shall be assembled and indexed in the order noted in

a table of contents. The contents of the assembled operation and maintenance manuals shall be as follows:

- a. Manufacturer's O&M information required by the paragraph entitled, "SD-10 Operation and Maintenance Data."
- b. Catalog data required by the paragraph entitled, "SD-03 Product Data."
- c. Drawing required by the paragraph entitled, "SD-02 Shop Drawings."
- d. Price for spare parts and supply list
- e. Routine and field acceptance test reports

1.6.2 Operation and Maintenance Data

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be secondary unit substations and related accessories are specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 SECONDARY UNIT SUBSTATION

Secondary Unit substations shall comply with IEEE C37.121 regardless of the kVA rating specified. Substation shall consist of one incoming section, one transformer section, and one outgoing section. Substation shall be designed for outdoor service with ventilation openings and gasketing provided to ensure a weatherproof assembly under rain, snow, sleet, and hurricane conditions. Substations shall be subassembled and coordinated by one manufacturer and shall be shipped in complete sections ready for connection at the site. Where practicable, substation shall be shipped as one unit. External doors shall have provisions for padlocking. Provide bird mitigation method for substation.

2.2.1 Incoming Section

The incoming section shall consist of a metal-enclosed interrupter switchgear section for connecting the incoming circuit through a fused load interrupter switch to the transformer. If required for proper connection and alignment, include a transition section with the incoming section.

2.2.1.1 Incoming Section Enclosure

The incoming section enclosure shall be NEMA ICS 6 Type as indicated. Bases, frames and channels of enclosure shall be corrosion resistant and

shall be fabricated of type 304 or 304L stainless steel. Base shall include any part of enclosure that is within 3 inches of concrete pad. Paint enclosure, including bases, ASTM D1535 light gray No. 61 or No. 49. Paint coating system shall comply with IEEE C57.12.29.

2.2.1.2 Cable Terminations

Provide medium voltage cable terminations as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

- a. 600 ampere deadbreak connector ratings: Voltage: 15 kV, 95 kV BIL. Short time rating: 40,000 rms symmetrical amperes. Connectors shall have 200 ampere bushing interface for surge arresters.

2.2.1.3 Surge Arresters

IEEE C62.11, rated 10kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Arresters shall be distribution class. Arresters for use at elevations in excess of 6000 feet above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations.

2.2.1.4 Load Interrupter Switch

IEEE C37.20.3. Provide a three-pole, single-throw, deadfront, metal-enclosed, load interrupter switch with manual stored energy operator. Switch shall be fused, with fuses mounted on a single frame and designed for easy inspection. The switch shall be operated by a manually charged spring stored energy mechanism which shall simultaneously disconnect or connect ungrounded conductors. The moveable blade of the switch shall be deenergized when in the open position. The mechanism shall enable the switch to close against a fault equal to the momentary rating of the switch without affecting its continuous current carrying or load interrupting ability. A ground bus shall extend the width of the switch enclosure and shall be bolted directly thereto. Connect frame of unit to ground bus. The door shall have an inspection window to allow full view of the position of the three switch blades through the closed door. Switch shall have provision for padlocking in the open and closed positions. Switch ratings shall be as follow:

Rated Maximum Voltage, kV	Rated Withstand Impulse Voltage, kV BIL	Continuous and Load Interrupting Current, A	Short-Circuit Current kA rms Sym	Short-Time / Fault-Close Current kA
15	95	600	25	40

2.2.1.5 Primary Protective Device Connection

Connections between the primary protective device and transformer shall be bus mounted on porcelain insulators, and sized and braced to withstand the specified short-circuit and short-time currents.

2.2.2 Transformer (Liquid-Filled) Section

ANSI C57.12.13. Less-flammable liquid-filled. The entire transformer assembly including, transformer base, the tank, radiators, flanges, base, lifting provisions, and hardware, shall be fabricated of ASTM A167 type 304, 304L, or 316 stainless steel. Transformer base shall include any part of the transformer that is within 3 inches of concrete pad. Paint coating system shall comply with IEEE C57.12.29.

2.2.2.1 Transformer Ratings

- a. Cooling Class: ONAN-Liquid-filled, self-cooled.
- b. Frequency: 60 Hz.
- c. Phases: Three phase.
- d. Rated Kilovolt Amperes: As indicated kVA
- e. Voltage Rating: As indicated
- f. Impedance: Minimum tested impedance shall not be less than 5.32 percent at 85 degrees C.
- g. Insulation Level: 95 kV BIL
- h. Temperature Rise: 65 degree C average winding temperature rise above a 30 degree ambient.
- i. Audible Sound Levels: Audible sound levels shall comply with the following:

<u>kVA Range</u>	<u>DECIBELS (MAX)</u>
225-300	55
1001-1500	60
3001-4000	64

2.2.2.2 Transformer Accessories

The transformer shall have the following accessories:

- a. Four 7.5 percent full capacity taps, two above and two below rated primary voltage such that the transformers can be set up for 450V vessels and 480V vessels.
- b. Tap changer, with external, pad-lockable, manual type operating handle, for changing tap setting when transformer is de-energized.
- c. Dead-front high-voltage bushings; IEEE 386. 15 kV, 95 kV BIL. Provide 600 ampere one piece deadbreak apparatus bushings.
- d. Parking stands: Provide a parking stand near each dead-front bushing. Provide insulated standoff bushings for parking of energized load-break connectors on each parking stands.

- e. Insulated low-voltage neutral bushing with lugs for ground cable and removable ground strap.
- f. Ground pads.
- g. Liquid-level indicator.
- h. Pressure-vacuum gage.
- i. Liquid temperature indicator.
- j. Drain and filter valves.
- k. Pressure relief device, top mounted, Qualitrol series 208.
- l. Diagrammatic stainless steel or laser-etched anodized aluminum nameplate in accordance with IEEE C57.12.00 and as modified or supplemented by this section.
- m. Transformer base with provisions for jacking and for rolling in either direction.
- n. Lifting provisions.
- o. Bolted transformer top or welded top with bolted handhole access.

2.2.2.3 Insulating Liquid

- a. Less-flammable transformer liquids: NFPA 70 and FM APP GUIDE for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D92 and a dielectric strength not less than 33 kV tested per ASTM D877/D877M. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

The fluid shall be a biodegradable electrical insulating and cooling liquid classified by UL and approved by FM as "less flammable" fluids. The fluid shall meet the following fluid properties:

- 1. Pour point: ASTM D97, less than -15 degree C
- 2. Aquatic biodegradation: EPA 712-C-98-075, 100 percent
- 3. Trout toxicity: OECD Test 203, zero mortality of EPA 821-R-02-012, pass

2.2.3 Outgoing Section

The outgoing section shall consist of a secondary transition section for connecting to a low-voltage switchgear section. The switchgear shall be as specified in Section 26 23 00 LOW VOLTAGE SWITCHGEAR 26 24 13 SWITCHBOARDS. Connections between the transformer secondary bushings and the outgoing section transition bus shall be flexible braid bus. The secondary transition section shall have a hinged front panel.

2.2.3.1 Outgoing Section Enclosure

Provide outgoing section enclosure in accordance with the requirements in paragraph entitled, "Incoming Section Enclosure".

2.2.4 Watthour and Digital Meters

2.2.4.1 Electronic Watthour Meter

NEMA/ANSI C12.10. Provide a switchboard style electronic programmable watthour meter, semi-drawout, semi-flush mounted, as indicated. Meter shall either be programmed at the factory or shall be programmed in the field. When field programming is performed, turn field programming device over to the Contracting Officer at completion of project. Meter shall be coordinated to system requirements.

- a. Design: Provide meter designed for use with 3 current transformers. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS) as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.
- b. Coordination: Provide meter coordinated with ratios of current transformers and transformer secondary voltage.
- c. Class 20. Form: 9S. Accuracy: plus or minus 1.0 percent. Finish: Class II.
- d. Kilowatt-hour Register: 5 digit electronic programmable type.
- e. Demand Register:
 1. Provide solid state.
 2. Meter reading multiplier: Indicate multiplier on the meter face.
 3. Demand interval length: shall be programmed for 15 minutes with rolling demand up to six subintervals per interval.

2.2.4.2 Digital Meters

IEEE C37.90.1 for surge withstand. Provide true rms, plus/minus one percent accuracy, programmable, microprocessor-based meters enclosed in sealed cases with a simultaneous three line display. Meters shall have 0.56 inch, minimum, LED's. The meters shall accept input from standard 5A secondary instrument transformers. Programming shall be via a front panel display and a communication interface with a computer. Password secured programming shall be stored in non-volatile EEPROM memory. Digital communications shall be coordinated with PWD. The meter shall calculate and store average max/min demand values for all readings based on a user selectable sliding window averaging period. The meter shall have programmable hi/low set limits with two Form C dry contact relays when exceeding alarm conditions. Historical trend logging capability shall include ability to store up to 100,000 data points with intervals of 1 second to 180 minutes. The unit shall also store and time stamp up to 100 programmable triggered conditions.

- a. Multi-Function Meter: Meter shall simultaneously display a selected phase to neutral voltage, phase to phase voltage, percent phase to neutral voltage THD, percent phase to phase voltage THD; a selected phase current, neutral current, percent phase current THD, percent neutral current; selected total PF, kW, kVA, kVAR, FREQ, kVAh, kWh. Detected alarm conditions include over/under current, over/under voltage, over/under kVA, over/under frequency, over/under selected

PF/kVAR, voltage phase reversal, voltage imbalance, reverse power, over percent THD. The meter shall have a Form C KYZ pulse output relay.

2.2.5 Instruments

ANSI C39.1 for electrical indicating switchboard style instruments, with 2 percent accuracy. The ac ammeters and voltmeters shall be minimum of 2 inches square, with 250 degree scale. Provide single phase indicating instruments with flush-mounted transfer switches for reading three phases.

2.2.6 Control Power Transformers

Transformer shall conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2.7 Meter Fusing

Provide a fuse block mounted in the metering compartment containing one fuse per phase to protect the voltage input to voltage sensing meters. Size fuses as recommended by the meter manufacturer.

2.2.8 Heaters

Provide 120-volt heaters in incoming section, and outgoing section. Heaters shall be of sufficient capacity to control moisture condensation in the compartments, shall be 250 watts minimum, and shall be controlled by a thermostat and humidistat located in each section. Thermostat shall be industrial type, high limit, to maintain compartments within the range of 60 to 90 degrees F. Humidistat shall have a range of 30 to 60 percent relative humidity. If heater voltage is different than substation equipment voltage, provide transformer rated to carry 125 percent of heater full load rating. Transformer shall have 220 degrees C insulation system with a temperature rise not exceeding 115 degrees C and shall conform to NEMA ST 20. Energize electric heaters while the equipment is in storage or in place prior to being placed in service. Provide method for easy connection of heater to external power source.

2.2.9 Insulated Barriers

Where insulated barriers are required by reference standards, provide barriers in accordance with NEMA LI 1, Type GPO-3, 0.25 inch minimum thickness.

2.2.10 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Terminal boards associated with current transformers shall be short-circuiting type. Terminate conductors for current transformers with ring-tongue lugs. Terminal board identification shall be identical in similar units. External wiring shall be color coded consistently for similar terminal boards.

2.2.11 Wire Marking

Mark control and metering conductors at each end. Provide factory-installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring,

provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Each sleeve shall contain a single letter or number, shall be elliptically shaped to securely grip the wire, and shall be keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Each wire marker shall indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.2.12 Grounding and Bonding

Provide as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.2.13 Cast-in-Place Concrete

Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. All concrete shall conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.3 MANUFACTURER'S NAMEPLATES

Each item of equipment shall have a nameplate bearing, as a minimum, the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable. Include additional information as applicable to fully identify the equipment. Nameplates shall be made of noncorrosive metal. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, provide nameplates for transformers, circuit breakers, meters, switches, and switchgear.

2.4 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each secondary unit substation, equipment enclosure, relay, switch, and device; as specified in this section or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.5 WARNING SIGNS

Provide warning signs for the enclosures of secondary unit substations having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.29, such as for secondary unit substations, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background.

2.6 SOURCE QUALITY CONTROL

2.6.1 Equipment Test Schedule

The Government will witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

Test Instrument Calibration

1. The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
3. Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.
4. Dated calibration labels shall be visible on all test equipment.
5. Calibrating standard shall be of higher accuracy than that of the instrument tested.
6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:
 - (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
 - (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.6.2 Load Interrupter Switch Production Tests

IEEE C37.20.3. Furnish reports of production tests performed on the actual equipment for this project. Required tests shall be as follows:

Production Tests

1. Dielectric
2. Mechanical operation
3. Grounding of instrument transformer case

2.6.3 Transformer Design Tests (Liquid-Filled)

In accordance with IEEE C57.12.00 and IEEE C57.12.90. Additionally, IEEE C57.12.80 section 5.1.2 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the product data and shop

drawings for each of the specified transformers. Design tests shall have been performed prior to the award of this contract.

- a. Tests shall be certified and signed by a registered professional engineer.
- b. Temperature rise: "Basically the same design" for the temperature rise test means a unit-substation transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (ONAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.
- c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a unit-substation transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include both the primary and secondary windings of that transformer.
 1. IEEE C57.12.90 paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.
 2. State test voltage levels.
 3. Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.
- d. Lifting and moving devices: "Basically the same design" for the lifting and moving devices test means a transformer in the same weight range as the transformer specified.
- e. Pressure: "Basically the same design" for the pressure test means a unit-substation transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

2.6.4 Transformer Routine and Other Tests (Liquid-Filled)

In accordance with IEEE C57.12.00 and IEEE C57.12.90. Routine and other tests shall be performed by the manufacturer on each of the actual transformers prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

- a. Cold resistance measurements (provide reference temperature)
- b. Phase relation
- c. Ratio
- d. Insulation power-factor by manufacturer's recommended test method.
- e. No-load losses (NLL) and excitation current
- f. Load losses (LL) and impedance voltage
- g. Dielectric
 1. Impulse: Per IEEE C57.12.90 paragraph 10.3 entitled "Lightning

Impulse Test Procedures," and IEEE C57.98. Test the primary winding only.

(a) State test voltage levels

(b) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test reports.

2. Applied voltage

3. Induced voltage

h. Leak

i. Sample insulating liquid. Sample shall be tested for:

1. Dielectric breakdown voltage

2. Acid neutralization number

3. Specific gravity

4. Interfacial tension

5. Color

6. Visual condition

7. Water in insulating liquid

8. Measure dissipation factor or power factor

j. Perform dissolved gas analysis (DGA)

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of the ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Substation Grounding

Provide bare copper cable not smaller than No. 4/0 AWG not less than 24 inches below grade interconnecting the indicated ground rods. Surge arrester and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with bare copper

conductors, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends. Substation transformer neutral connections shall not be smaller than No. 1/0 AWG. When work in addition to that indicated or specified is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION, paragraph regarding "Grounding".

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect unit substations furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Interrupter Switchgear

IEEE C37.20.3.

3.3.2 Meters and Instrument Transformers

ANSI C12.1.

3.3.3 Field Applied Painting

Where field applied painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.3.4 Field Fabricated Nameplate Mounting

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3.5 Warning Sign Mounting

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.4.1 Exterior Location

Refer to the structural drawings and specification for exterior platform provision.

3.4.2 Interior Location

Mount unit substation on concrete slab. Unless otherwise indicated, the

slab shall be at least 4 inches thick. The top of the concrete slab shall be approximately 4 inches above finished floor. Edges above floor shall have 1/2 inch chamfer. The slab shall be of adequate size to project at least 4 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter. Cut off and bush conduits 3 inches above slab surface.

3.4.3 Cast-in-Place Concrete

Cast-in-place concrete work shall conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.5 FIELD QUALITY CONTROL

3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Interrupter Switchgear (Air Switches)

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.
2. Inspect physical and mechanical condition.
3. Confirm correct application of manufacturer's recommended lubricants.
4. Verify appropriate anchorage and required area clearances.
5. Verify appropriate equipment grounding.
6. Verify correct blade alignment, blade penetration, travel stops, and mechanical operation.
7. Verify that fuse sizes and types correspond to approved shop drawings.
8. Verify that each fuse holder has adequate mechanical support.
9. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
10. Test interlocking systems for correct operation and sequencing.
11. Verify correct phase barrier materials and installation.
12. Compare switch blade clearances with industry standards.
13. Inspect all indicating devices for correct operation

b. Electrical Tests

1. Perform insulation-resistance tests.
2. Perform over-potential tests.
3. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
4. Measure closed contact-resistance across each switch blade and fuse holder.
5. Measure fuse resistance.
6. Verify heater operation.

3.5.1.2 Transformers (Liquid-Filled)

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.
2. Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.
4. Verify operation of all alarm, control, and trip circuits from temperature and level indicators, pressure relief device, and fault pressure relay.
5. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
6. Verify correct liquid level in transformer tank.
7. Perform specific inspections and mechanical tests as recommended by manufacturer.
8. Verify correct equipment grounding.
9. Verify the presence of transformer surge arresters.

b. Electrical Tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
2. Perform dissolved gas analysis (DGA).
3. Verify that the tap-changer is set at specified ratio.
4. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.5.1.3 Current Transformers

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.
2. Inspect physical and mechanical condition.
3. Verify correct connection.
4. Verify that adequate clearances exist between primary and secondary circuit.
5. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
6. Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
2. Perform insulation-resistance tests.
3. Perform polarity tests.
4. Perform ratio-verification tests.

3.5.1.4 Metering and Instrumentation

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.
2. Inspect physical and mechanical condition.
3. Verify tightness of electrical connections.

b. Electrical Tests

1. Verify accuracy of meters at 25, 50, 75, and 100 percent of full scale.
2. Calibrate watthour meters according to manufacturer's published data.
3. Verify all instrument multipliers.
4. Verify that current transformer and voltage transformer secondary circuits are intact.

3.5.1.5 Grounding System

a. Visual and Mechanical Inspection

1. Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

1. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.
2. Submit the measured ground resistance of each ground rod or grounding system, indicating the location of the rod or grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.5.2 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Relay settings shall be implemented as directed by the Contracting Officer. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

3.5.3 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer.

3.5.4 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Test shall require each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days' advance notice of the dates and times for checks, settings, and tests.

3.6 Special Testing for Seismic-Resisting Equipment

Equipment is required to remain operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise. Seismic component qualification documentation for each piece of equipment must contain the information required in UFC 3-301-02, Section 2-17.2.5 Component Qualification Documentation. Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be less than 5 inches by 7 inches with red letters 1-inch in height on a white background stating "Certified Equipment". The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file." The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

3.7 Special Inspection for Seismic-Resisting Systems and Equipment

Perform special inspections for seismic-resisting systems, equipment and components for structures assigned to Risk Category IV per Section 01 45 35 SPECIAL INSPECTIONS.

-- End of Section --

SECTION 26 12 19.10

THREE-PHASE, LIQUID-FILLED PAD-MOUNTED TRANSFORMERS
05/19, CHG 1: 11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M	(2020a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM D92	(2012a) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D97	(2017b) Standard Test Method for Pour Point of Petroleum Products
ASTM D877/D877M	(2019) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D1535	(2014; R 2018) Standard Practice for Specifying Color by the Munsell System

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C37.47	(2011) Standard for High Voltage Distribution Class Current-Limiting Type Fuses and Fuse Disconnecting Switches
IEEE C57.12.00	(2015) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

IEEE C57.12.28	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE C57.12.34	(2015) Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 10 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below
IEEE C57.12.80	(2010) Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	(2015; Corr 2017) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.98	(2011) Guide for Transformer Impulse Tests
IEEE C62.11	(2020) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 260	(1996; R 2004) Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas
NEMA Z535.4	(2011; R 2017) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1992) Fish Acute Toxicity Test
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U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 712-C-98-075	(1998) Fate, Transport and Transformation
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Test Guidelines - OPPTS 835.3100- "Aerobic
Aquatic Biodegradation"

EPA 821-R-02-012

(2002) Methods for Measuring the Acute
Toxicity of Effluents and Receiving Waters
to Freshwater and Marine Organisms

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 431

Energy Efficiency Program for Certain
Commercial and Industrial Equipment

UNDERWRITERS LABORATORIES (UL)

UL 467

(2013; Reprint Jun 2017) UL Standard for
Safety Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section,
with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms
used in these specifications, and on the drawings, are as defined in
IEEE Stds Dictionary.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S"
classification. Submittals not having a "G" or "S" classification are for
Contractor Quality Control approval. Submit the following in accordance
with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pad-mounted Transformer Drawings; G

SD-03 Product Data

Pad-mounted Transformers; G

SD-06 Test Reports

Acceptance Checks and Tests; G

SD-07 Certificates

Transformer Efficiencies; G

SD-09 Manufacturer's Field Reports

Transformer Test Schedule; G

Pad-mounted Transformer Design Tests; G

Pad-mounted Transformer Routine and Other Tests; G

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5; G

1.4.1 Reduced Submittal Requirements

Transformers designed and manufactured by ABB in Jefferson City, MO; by Eaton's Cooper Power Series Transformers in Waukesha, WI; by ERMCO in Dyersburg, TN; or by Howard Industries in Laurel, MS need not submit the entire submittal package requirements of this contract. Instead, submit the following items:

- a. A certification, signed by the manufacturer, stating that the manufacturer will meet the technical requirements of this specification.
- b. An outline drawing of the transformer with devices identified (paragraph PAD-MOUNTED TRANSFORMER DRAWINGS, item a).
- c. ANSI nameplate data of the transformer (paragraph PAD-MOUNTED TRANSFORMER DRAWINGS, item b).
- d. Manufacturer's published time-current curves in PDF format and in electronic format suitable for import or updating into the SKM PowerTools for Windows computer program of the transformer high side fuses (paragraph PAD-MOUNTED TRANSFORMER DRAWINGS, item e).
- e. Provide transformer test schedule and routine and other tests required by submittal item "SD-09 Manufacturer's Field Reports".
- f. Provide acceptance test reports required by submittal item "SD-06 Test Reports".
- g. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

1.5 QUALITY ASSURANCE

1.5.1 Pad-Mounted Transformer Drawings

Include the following as a minimum:

- a. An outline drawing, including front, top, and side views.
- b. IEEE nameplate data.
- c. Elementary diagrams and wiring diagrams with terminals identified of watt-hour meter and current transformers.
- d. One-line diagram, including switch(es), current transformers, meters, and fuses.
- e. Manufacturer's published time-current curves in PDF format and in electronic format suitable for import or updating into the SKM PowerTools for Windows computer program of the transformer high side fuses.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, except of NFPA 70 when more stringent requirements are specified or indicated, as though the word "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with NFPA 70 unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.6 MAINTENANCE

1.6.1 Additions to Operation and Maintenance Data

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

- a. An instruction manual with pertinent items and information highlighted
- b. An outline drawing, front, top, and side views
- c. Prices for spare parts and supply list
- d. Routine and field acceptance test reports
- e. Fuse curves for primary fuses

f. Actual nameplate diagram

g. Date of purchase

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.28 and as specified herein. Submit manufacturer's information for each component, device, insulating fluid, and accessory provided with the transformer.

2.2.1 Compartments

Provide high- and low-voltage compartments separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment contains: the incoming line, insulated high-voltage dead-break connectors, six high-voltage one-piece bushings configured for loop feed application, load-break switch handle(s), access to oil-immersed bayonet fuses, dead-front surge arresters, tap changer handle, connector parking stands, and ground pad.

- a. Insulated high-voltage dead-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 600 amperes rms continuous. Short time rating: 25,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector must have a 600 ampere bushing interface for surge arresters, steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.
- b. One-piece bushings: IEEE 386, 600 amperes, 15 kV Class.
- c. Load-break switch

Loop feed sectionalizer switches: Provide three, two-position, oil-immersed type switches to permit closed transition loop feed and sectionalizing. Each switch must be rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 600 amperes, and a make-and-latch rating of 12,000 rms amperes symmetrical. Locate the switch handles in the high-voltage compartment. Operation of switches must be as follows:

ARRANGEMENT NO.	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION					
		LINE A SW.		LINE B SW		XFMR. SW	
		OPEN	CLOSE	OPEN	CLOSE	OPEN	CLOSE
1	Line A connected to Line B and both lines connected to transformer		X		X		X
2	Transformer connected to Line A only		X	X			X
3	Transformer connected to Line B only	X			X		X
4	Transformer open and loop closed		X		X	X	
5	Transformer open and loop open	X		X		X	

- d. Provide bayonet oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. The bayonet fuse links sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. Include an oil retention valve inside the bayonet assembly housing, which closes when the fuse holder is removed, and an external drip shield to minimize oil spills. Display a warning label adjacent to the bayonet fuse(s) cautioning against removing or inserting fuses unless the transformer has been de-energized and the tank pressure has been released.

Bayonet fuse assembly: 150 kV BIL.

Oil-immersed current-limiting fuses: IEEE C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.

- e. Surge arresters: IEEE C62.11, rated 10 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap. Provide three arresters for loop feed circuits.

- f. Parking stands: Provide a parking stand near each bushing.

2.2.1.2 Low Voltage

Low-voltage compartment contains: low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

- a. Include the following accessories: drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

- b. Metering: Provide as specified in Section 26 27 14.00 20 ELECTRICITY METERING.

2.2.2 Transformer

- a. Less-flammable liquid-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.
- b. Transformer rated as indicated.
- c. Transformer voltage ratings: as indicated.
- d. Tap changer: externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Indicate which tap setting is in use, clearly visible when the compartment is opened.
- e. Minimum tested percent impedance at 85 degrees C:
- 2.50 for units rated 75kVA and below
2.87 for units rated 112.5kVA to 300kVA
4.03 for 500kVA rated units
5.32 for units rated 750kVA and above
- f. Comply with the following audible sound level limits:

<u>kVA</u>	<u>DECIBELS</u> (MAX)
75	51
112.5	55
150	55
225	55
300	55
500	56
750	57
1000	58
1500	60
2000	61
2500	62

- g. Include:

(1) Lifting lugs and provisions for jacking under base, with base

construction suitable for using rollers or skidding in any direction.

- (2) An insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.
- (3) Provide transformer top with an access handhole.

2.2.2.1 Specified Transformer Efficiencies

Provide transformer efficiency calculations utilizing the actual no-load and load loss values obtained during the routine tests performed on the actual transformer(s) prepared for this project. Reference no-load losses (NLL) at 20 degrees C. Reference load losses (LL) at 55 degrees C and at 50 percent of the nameplate load. The transformer is not acceptable if the calculated transformer efficiency is less than the efficiency indicated in the "KVA / Efficiency" table below. The table is based on requirements contained within 10 CFR 431, Subpart K. Submit certification, including supporting calculations, from the manufacturer indicating conformance.

<u>kVA</u>	<u>EFFICIENCY</u> <u>(percent)</u>
15	98.65
30	98.83
45	98.92
75	99.03
112.5	99.11
150	99.16
225	99.23
300	99.27
500	99.35
750	99.40
1000	99.43
1500	99.48
2000	99.51
2500	99.53
above 2500	99.54

2.2.3 Insulating Liquid

- a. Less-flammable transformer liquids: NFPA 70 and FM APP GUIDE for

less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D92 and a dielectric strength not less than 33 kV tested per ASTM D877/D877M. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

Provide a fluid that is a biodegradable, electrical insulating, and cooling liquid classified by UL and approved by FM as "less flammable" with the following properties:

- (1) Pour point: ASTM D97, less than -15 degree C
- (2) Aquatic biodegradation: EPA 712-C-98-075, ultimately biodegradable as designated by EPA.
- (3) Trout toxicity: OECD Test 203, zero mortality of EPA 821-R-02-012, pass

2.2.3.1 Liquid-Filled Transformer Nameplates

Provide nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

2.2.4 Corrosion Protection

Provide corrosion resistant bases and cabinets of transformers, fabricated of stainless steel conforming to ASTM A240/A240M, Type 304 or 304L. Base includes any part of pad-mounted transformer that is within 3 inches of concrete pad.

Provide entire transformer assembly, including tank and radiator, base, enclosure, and metering enclosure fabricated of stainless steel conforming to ASTM A240/A240M, Type 304 or 304L. Form enclosure of stainless steel sheets. The optional use of aluminum is permitted for the metering enclosure.

Paint entire transformer assembly Munsell 7GY3.29/1.5 green, with paint coating system complying with IEEE C57.12.28 and IEEE C57.12.29 regardless of base, cabinet, and tank material. The Munsell color notation is specified in ASTM D1535.

2.3 WARNING SIGNS AND LABELS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts in accordance with NEMA Z535.4 and NEMA 260.

- a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning labels on the outside of the high voltage compartment door(s) with nominal dimensions of 7 by 10 inches with the legend "WARNING HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. Include the word "WARNING" in white letters on an orange background and the words "HIGH VOLTAGE" in black letters on a white background.

2.4 ARC FLASH WARNING LABEL

Provide arc flash warning label for the enclosure of pad-mounted transformers. Locate this self-adhesive warning label on the outside of

the high voltage compartment door warning of potential electrical arc flash hazards and appropriate PPE required. Provide label format as indicated.

2.5 GROUNDING AND BONDING

UL 467. Provide grounding and bonding as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.6 CAST-IN-PLACE CONCRETE

Provide concrete associated with electrical work for other than encasement of underground ducts rated for 4000 psi minimum 28-day compressive strength unless specified otherwise. Conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

Provide concrete associated with electrical work as follows:

- a. Composed of fine aggregate, coarse aggregate, portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture.
- b. Fine aggregate: hard, dense, durable, clean, and uncoated sand.
- c. Coarse aggregate: reasonably well graded from 3/16 inch to 1 inch.
- d. Fine and coarse aggregates: free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances.
- e. Water: fresh, clean, and free from salts, alkali, organic matter, and other impurities.
- f. Concrete associated with electrical work for other than encasement of underground ducts: 4000 psi minimum 28-day compressive strength unless specified otherwise.
- g. Slump: Less than 4 inches. Retempering of concrete will not be permitted.
- h. Exposed, unformed concrete surfaces: smooth, wood float finish.
- i. Concrete must be cured for a period of not less than 7 days, and concrete made with high early strength portland cement must be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed by the Contracting Officer.
- j. Air entrain concrete exposed to weather using an air-entraining admixture conforming to ASTM C260/C260M.
- k. Air content: between 4 and 6 percent.

2.7 SOURCE QUALITY CONTROL

2.7.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify

Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

- (1) Provide a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
- (2) Accuracy: Traceable to the National Institute of Standards and Technology.
- (3) Instrument calibration frequency schedule: less than or equal to 12 months for both test floor instruments and leased specialty equipment.
- (4) Dated calibration labels: visible on all test equipment.
- (5) Calibrating standard: higher accuracy than that of the instrument tested.
- (6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:
 - (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
 - (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.7.2 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for each of the specified transformer(s), with design tests performed prior to the award of this contract.

- a. Tests: certified and signed by a registered professional engineer.
- b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (KNAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.
- c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests includes the primary windings only of that transformer.
 - (1) IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.
 - (2) State test voltage levels.

(3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

- d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.34.
- e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.
- f. Short circuit: "Basically the same design" for the short circuit test means a pad-mounted transformer with the same kVA as the transformer specified.

2.7.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests: performed in accordance with IEEE C57.12.90 by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence as follows:

- a. Phase relation
- b. Ratio
- c. No-load losses (NLL) and excitation current
- d. Load losses (LL) and impedance voltage
- e. Dielectric
 - (1) Impulse
 - (2) Applied voltage
 - (3) Induced voltage
- f. Leak

PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 25 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide a ground ring around the transformer with 4/0 AWG bare copper. Provide four ground rods in the ground ring, one per corner. Install the ground rods at least 10 feet apart from each other. Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" applies.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.4 FIELD APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.5 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab as follows:

- a. Unless otherwise indicated, provide the slab with dimensions at least 8 inches thick, reinforced with a 6 by 6 inches - W2.9 by W2.9 mesh placed uniformly 4 inches from the top of the slab.
- b. Place slab on a 6 inch thick, well-compacted gravel base.
- c. Install slab such that top of concrete slab is approximately 4 inches above the finished grade with gradual slope for drainage.
- d. Provide edges above grade with 1/2 inch chamfer.
- e. Provide slab of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.5.1 Cast-In-Place Concrete

Provide cast-in-place concrete work in accordance with the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.5.2 Sealing

When the installation is complete, seal all entries into the equipment enclosure with an approved sealing method. Provide seals of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.6 FIELD QUALITY CONTROL

3.6.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS. Submit reports, including acceptance criteria and limits for each test in accordance with NETA ATS "Test Values".

3.6.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.
- (3) Inspect anchorage, alignment, and grounding.
- (4) Verify the presence of PCB content labeling.
- (5) Verify the bushings and transformer interiors are clean.
- (6) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (7) Verify correct liquid level in tanks and bushings.
- (8) Verify that positive pressure is maintained on gas-blanketed transformers.
- (9) Perform specific inspections and mechanical tests as recommended by manufacturer.
- (10) Verify de-energized tap changer position is left as specified.
- (11) Verify the presence of transformer surge arresters.

b. Electrical tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.
- (2) Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.
- (3) Perform insulation-resistance tests, winding-to-winding and each winding-to-ground. Calculate polarization index. Verify that the tap changer is set at the specified ratio.
- (4) Perform turns-ratio tests at all tap positions.
- (5) Perform insulation power-factor or dissipation-factor tests on all windings in accordance with test equipment manufacturer's published data.
- (6) Perform power-factor or dissipation-factor tests on each bushing equipped with a power-factor/capacitance tap. In the absence of a power-factor/capacitance tap, perform hot-collar tests.
- (7) Measure the resistance of each high-voltage winding in each de-energized tap-changer position. Measure the resistance of each low-voltage winding in each de-energized tap-changer position, if applicable.
- (8) Remove and test a sample of insulating liquid for the following: Dielectric breakdown voltage, Acid neutralization number, Specific gravity, Interfacial tension, Color, Visual Condition, Water in insulating liquids (Required on 25 kV or higher voltages and on all silicone-filled units.), and Power factor or dissipation factor.
- (9) Perform dissolved-gas analysis (DGA) on a sample of insulating liquid.

3.6.1.2 Current Transformers

a. Visual and mechanical inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Verify correct connection.
- (4) Verify that adequate clearances exist between primary and secondary circuit wiring.
- (5) Verify the unit is clean.
- (6) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (7) Verify that all required grounding and shorting connections

provide good contact.

- (8) Verify correct operation of transformer withdrawal mechanism and grounding operation.
- (9) Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

b. Electrical tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
- (2) Perform insulation-resistance test.
- (3) Perform a polarity test.
- (4) Perform a ratio-verification test.

3.6.1.3 Watthour Meter

a. Visual and mechanical inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Verify tightness of electrical connections.

b. Electrical tests

- (1) Calibrate watthour meters according to manufacturer's published data.
- (2) Verify that correct multiplier has been placed on face of meter, where applicable.
- (3) Verify that current transformer secondary circuits are intact.

3.6.1.4 Grounding System

a. Visual and mechanical inspection

- (1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

- (1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or

grounding systems under test.

- (2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.6.1.5 Surge Arresters, Medium- and High-Voltage

a. Visual and mechanical inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Inspect anchorage, alignment, grounding, and clearances.
- (4) Verify the arresters are clean.
- (5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (6) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

b. Electrical tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
- (2) Perform an insulation-resistance test on each arrester, phase terminal-to-ground.
- (3) Test grounding connection.

3.6.2 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, notify the Contracting Officer 5 working days in advance of the dates and times of checking and testing.

-- End of Section --

SECTION 26 13 00

SF6/HIGH-FIREPOINT FLUIDS INSULATED PAD-MOUNTED SWITCHGEAR
11/14

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM D1535	(2014; R 2018) Standard Practice for Specifying Color by the Munsell System
ASTM D2472	(2000; R 2014) Standard Specification for Sulphur Hexafluoride
ASTM D6871	(2017) Standard Specification for Natural (Vegetable Oil) Ester Fluids Used in Electrical Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C37.60	(2019) High-Voltage Switchgear and Controlgear - Part 111: Automatic Circuit Reclosers for Alternating Current Systems Up to 38 kV
IEEE C37.74	(2014) Standard Requirements for Subsurface, Vault, and Pad-Mounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems Up to 38 kV
IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE C62.11	(2020) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2017; Errata 2017) Standard for
Acceptance Testing Specifications for
Electrical Power Equipment and Systems

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61099 (2010; ED 2.0) Insulating Liquids -
Specifications for Unused Synthetic
Organic Esters for Electrical Purposes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 70B (2019) Recommended Practice for Electrical
Equipment Maintenance

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 8500.01 (2014; Change 1-2019) Cybersecurity

DOD 8510.01 (2014; Change 1-2016; Change 2-2017) Risk
Management Framework (RMF) for DoD
Information Technology (IT)

UNDERWRITERS LABORATORIES (UL)

UL 467 (2013; Reprint Jun 2017) UL Standard for
Safety Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING, applies to this
section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Switched Way

A switched way is considered a three-phase circuit entrance to the bus
through a switch. For single-phase switches, it is a single-phase entrance
to the bus through a switch.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S"
classification. Submittals not having a "G" or "S" classification are for
Contractor Quality Control approval. Submit the following in accordance
with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchgear Drawings; G

SD-03 Product Data

Electronic Overcurrent Control Curves; G

SF6/High-Firepoint Fluid Insulated Pad-mounted Switchgear; G

Insulated High-Voltage Connectors; G

Surge Arresters; G

SD-06 Test Reports

Acceptance Checks and Tests; G

SD-07 Certificates

Paint Coating System; G

Cybersecurity; GSD-09 Manufacturer's Field Reports

Switchgear design and production tests; G

SD-10 Operation and Maintenance Data

SF6/High-Firepoint Fluid Insulated Pad-mounted Switchgear, Data
Package 5; G

Submit in accordance with Section 01 78 23 OPERATION AND
MAINTENANCE DATA.

1.5 QUALITY ASSURANCE

1.5.1 Switchgear Drawings

Furnish drawings that include, but are not limited to, the following:

- a. Overall dimensions, weights, plan view, and front view
- b. Ratings
- c. Single-line diagram.

1.5.2 Paint Coating System

Submit IEEE C57.12.29 paint coating system performance requirement tests.

1.5.3 Electronic Overcurrent Control Curves

Provide time-current characteristic curves in PDF format and in electronic
format suitable for import or updating into the SKM PowerTools for Windows
computer program).

1.6 MAINTENANCE

1.6.1 SF6/High-Firepoint Fluid Insulated Pad-mounted Switchgear Operation
and Maintenance

Submit Operation and Maintenance Manuals in accordance with Section
01 78 23 OPERATION AND MAINTENANCE DATA.

1.7 CYBERSECURITY

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed and maintained in accordance with DOD 8500.01 and DOD 8510.01, and as required by individual Service Implementation Policy.

Submit certification that equipment complies with the above DoD instructions.

PART 2 PRODUCTS

2.1 SF6/HIGH-FIREPOINT FLUID INSULATED PAD-MOUNTED SWITCHGEAR

IEEE C37.74

2.1.1 Ratings and Test Requirements

The voltage rating of the switchgear must be as indicated. Provide the corresponding ratings associated with the required switchgear voltage rating as follows:

Rated Maximum Voltage, kV	15.5
Rated Withstand Impulse Voltage, kV BIL	95
Continuous and Load Interrupting Current, A	600
Short-Time Current, kA rms Sym	25
Short-Circuit interrupting Current, kA rms Sym	25

2.1.2 Switchgear Construction

Provide switchgear with switch contacts and cable entrance terminations contained in a sealed, dielectric-filled stainless steel tank. Switchgear must be shipped factory filled with appropriate levels of SF6 gas conforming to ASTM D2472 or less-flammable, high-firepoint biodegradable fluid conforming to ASTM D6871 and IEC 61099. Configure switchgear with fault interrupting switched ways for all incoming and outgoing ways. Provide switchgear with front accessible terminations suitable for cables entering from below with manual operating provisions either mounted on the rear or capable of hookstick operation per IEEE C37.74. Switch contact positions for switched ways must be visible through viewing windows in the switchgear tank located adjacent to the manual operating provisions. Provide internal gas pressure gage or fluid level gage in viewable location from switch operating handle. Provide each switched way with three position switch; Open, Closed, Ground.

2.1.2.1 Pad-mounting Provisions

Provide ENCLOSED switchgear suitable for installation on a concrete pad. Switchgear assembly, including support frame, tank, enclosure base, and enclosure shall be fabricated of ASTM A167 type 304 or 304L stainless steel. Enclosure base shall include any part of the switchgear enclosure that is within 3 inches of concrete pad. Paint switchgear enclosure

including base ASTM D1535 Munsell 7GY3.29/1.5 green. Switchgear tank and support frame are not required to be munsell green. Paint coating system shall comply with IEEE C57.12.29 regardless of equipment material. Connector compartment of the enclosure shall be sized as needed to accommodate the use of 200A elbows in series with the 600A connectors.

2.1.3 Fault Interrupting Switched Ways

IEEE C37.60, IEC 62271-111. Provide non-fused, non-reclosing, manual reset, vacuum interrupters consisting of vacuum interrupter and a spring assisted operating mechanism. Each fault interrupting switched way must utilize internally mounted current transformers and an electronic overcurrent control to provide three-pole ganged tripping for single-phase and three-phase faults. Provide electronic overcurrent control with provisions for a minimum of ten field changeable overcurrent trip settings. Provide remote tripping via an external dry contact device for fault interrupting switched ways. Provide 120Vac from the switchgear itself.

2.1.4 Automatic Switch Controls

Provide an automatic switch control system to execute Manual, SCADA operations (Provision for future). Power the switch control system and associated communication port provisions from an integral battery-charger DC supply system. Use motor operators and associated motor operator controllers for switch way operation. Use 120 Vac control power for automatic switch control.

2.1.4.1 Manual Operation

Provide the motor operator controllers with "Close" and "Open" pushbuttons for manual operation.

2.1.4.2 SCADA Operation (Provision for future)

The automatic switch control system must execute remote commands received from a SCADA master station and transmit switchgear operation information to a SCADA master station via a DNP 3.0 100Base-FX Ethernet communication port. Include transfer of switch ways to "Close" and "Open" positions and enabling of the Source-Transfer operation for execution of remote commands. Include switch way position status, voltage and current readings, and DC supply system status with communication of switchgear information.

2.1.5 Dead-Front High-Voltage Bushings

IEEE 386. 15 kV, 95 kV BIL. Provide 600 ampere one-piece deadbreak apparatus bushings for each switched way. Provide live-end caps for all unused ways. Caps shall be rated 15kV and shall include test points.

- a. Parking stands: Provide a parking stand near each dead-front bushing. Provide insulated standoff bushings for parking of energized load-break connectors on each parking stands.

2.2 Insulated High-Voltage Connectors

IEEE 386. Provide corresponding connector for each switched way. Provide a grounding eye and test point on each connector.

- a. 600 Ampere deadbreak connector ratings: Voltage: 15 kV, 95 kV BIL. Short time rating: 25,000 rms symmetrical amperes. Provide 600 ampere dead break connectors with 200 ampere bushing interface.
- b. Provide one sets of three grounding elbows. Deliver grounding elbows to the Contracting Officer.

2.3 Surge Arresters

IEEE C62.11, rated 10 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Provide arresters on switched ways as indicated.

2.4 SF6 Refill Cylinders

Provide two SF6 refill cylinders, minimum size of 6 pounds of SF6; include regulator, valves, and hose for connection to the fill valve of the switch.

2.5 SOURCE QUALITY CONTROL

2.5.1 Switchgear Design and Production Tests

Furnish reports which include results of design and production tests performed according to IEEE C37.74 and IEEE C37.60. Perform manufacturer production tests on each switchgear assembly to ensure that design performance is maintained in production.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.2 GROUNDING

NFPA 70 and IEEE C2, except provide grounds and grounding systems with a resistance to solid earth ground not exceeding 25 ohms. When work, in addition to that indicated or specified, is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" applies.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION at each corner of switchgear pad. Ground rod dimensions shall be a minimum 3/4 inch x 12 feet and select as appropriate to match the rest of the spec.

3.2.2 Switchgear Grounding

Connect #4/0 bare copper conductor ground ring, not less than 24 inches below grade, to the upper end of the ground rods by exothermic welds or compression connectors. Provide #4/0 bare copper conductors connecting the switchgear grounding provisions to two different ground rods.

3.2.3 Connections

Make joints in grounding conductors and ground ring by exothermic weld or

compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount switch on concrete slab. Provide slab with dimensions at least 12 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Place slab on a 6 inch thick, well-compacted gravel base. Install top of concrete slab approximately 4 inches above finished grade. Provide edges above grade with 1/2 inch chamfer. Provide slab of adequate size to project at least 8 inches beyond the maximum projected dimensions of the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with switch cable training areas. Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.4 FIELD QUALITY CONTROL

3.4.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS and referenced ANSI standards.

Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.4.1.1 Switchgear

a. Visual and Mechanical Inspection

1. Compare equipment nameplate information with specifications and approved shop drawings.
2. Inspect physical and mechanical condition.
3. Check for proper anchorage, alignment, required area clearances, and grounding.
4. Perform mechanical operator tests in accordance with manufacturer's instructions.
5. Verify that insulating SF6 gas pressure or dielectric fluid level is correct.
6. Inspect all indicating devices for proper operation.

b. Electrical Tests

1. Perform contact-resistance tests.
2. Trip fault interrupters by operation of overcurrent control.

3. Perform insulation-resistance tests.
4. Perform an over-potential test on each switched way pole with the switched way in the open position in accordance with the manufacturer's instructions.
5. Set fault interrupter overcurrent control in accordance with government provided settings. Request settings from government, in writing, a minimum of 30 days prior to scheduling electrical tests.

3.4.1.2 Grounding System

a. Visual and Mechanical Inspection

Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

1. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.
2. Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.4.2 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that devices are in good operating condition and properly performing the intended function. Perform each test function not less than three times. As an exception to requirements stated elsewhere in the contract, notify the Contracting Officer five working days in advance of the dates and times for checks and tests.

3.5 FAULT INDICATORS WITH REMOTE DISPLAY

Provide underground cable fault indicators on each 600 amp switch way. Fault indicators shall be suitable for operation on a 15KV system. Indicators shall be self-reset type having time reset with current restoration override optional times of 0, 2, 4, 8, and 12 hours. Each indicator shall have a trip range of 50 to 1,200 amperes. Provide high capacity lithium battery having an approximate life of 20 years. Battery shall be integral to the fault indicator. Battery shall be suitable to power a remote display. Both fault indicator and battery shall be capable of operating between -40 degree F to + 185 degree F.

3.5.1 Remote Display

Provide each fault indicator with remote interface and transceivers compatible with the existing base wide radio ranger system. Remote display shall consist of a LED display on a transceiver that can be read remotely utilizing unlicensed radio technology. Provide a minimum of two remote readers that communicate with the transceivers provided at each switch. The remote readers shall display the status of the fault indication in the switches without having to open the switch enclosures. Fiber-optic cable length shall be long enough so that the cable can be trained away from other indicators without interfering with the operation or maintenance of the switch. The entire remote display shall be detachable from the fault indicator.

-- End of Section --

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SECTION 26 13 01

PAD-MOUNTED DEAD-FRONT AIR INSULATED SWITCHGEAR

08/13, CHG 1: 02/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M (2020a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM D1535 (2014; R 2018) Standard Practice for Specifying Color by the Munsell System

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386 (2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV

IEEE 495 (2007) Guide for Testing Faulted Circuit Indicators

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

IEEE C37.74 (2014) Standard Requirements for Subsurface, Vault, and Pad-Mounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems Up to 38 kV

IEEE C57.12.29 (2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

IEEE C62.11 (2020) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA

20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 70B (2019) Recommended Practice for Electrical
Equipment Maintenance

UNDERWRITERS LABORATORIES (UL)

UL 467 (2013; Reprint Jun 2017) UL Standard for
Safety Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING, applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Switched Way

A switched way is considered a three-phase circuit entrance to the bus through a switch.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchgear Drawings; G

SD-03 Product Data

Fuse Time-Current Characteristic Curves; G

Air Insulated Pad-mounted Switchgear; G

Insulated High-Voltage Connectors; G

Surge Arresters; G

SD-06 Test Reports

Acceptance Checks and Tests; G

SD-07 Certificates

Paint Coating System; G

SD-09 Manufacturer's Field Reports

Switchgear Design and Production Tests; G

SD-10 Operation and Maintenance Data

Air Insulated Pad-Mounted Switchgear Operation and Maintenance,

Data Package 5; G

1.5 QUALITY ASSURANCE

1.5.1 Switchgear Drawings

Furnish drawings that include, but are not limited to, the following:

- a. Overall dimensions, weights, plan view, and front view
- b. Ratings
- c. Single-line diagram.

1.5.2 Paint Coating System

Submit IEEE C57.12.29 paint coating system performance requirement tests.

1.5.3 Fuse Time-Current Characteristic Curves

Provide time-current characteristic curves in PDF format and in electronic format suitable for import or updating into the SKM PowerTools for Windows computer program.

1.6 MAINTENANCE

1.6.1 Air Insulated Pad-mounted Switchgear Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 AIR INSULATED PAD-MOUNTED SWITCHGEAR

IEEE C37.74. Submit manufacturer's information on switches and each component, device, and accessory provided with the equipment.

2.1.1 Ratings and Test Requirements

Provide switchgear with a nominal voltage rating of 14.4 kV and the following corresponding ratings:

Rated Maximum Voltage, kV	17
Rated Withstand Impulse Voltage, kV BIL	95
Continuous and Load Interrupting Current, A	600
Short-Circuit Current, kA rms Sym	25
Power Fuses, Amperes, Maximum Interrupting, kA rms Sym	25

Provide switched ways rated for the required continuous and load interrupting current.

2.1.2 Switchgear Construction

Provide switchgear with the following construction and configuration:

- a. Switch contacts and cable entrance terminations contained in an enclosed, steel compartment.
- b. Configured with load interrupting and fused switched ways as indicated.
- c. Accessible terminations suitable for cables entering from below.
- d. Switch contact positions for switched ways visible through viewing windows in the switchgear termination compartment.
- e. Each switched way with two position switch; Open, Closed and provisions for grounding.

2.1.2.1 Pad-mounting Provisions

Provide enclosed switchgear suitable for installation on a concrete pad, including the following:

- a. Fabricate switchgear enclosure and enclosure base of ASTM A240/A240M type 304 or 304L stainless steel.
- b. Enclosure base includes any part of the switchgear enclosure that is within 3 inches of concrete pad.
- c. Paint enclosure including base ASTM D1535 Munsell 7GY3.29/1.5 green.
- d. Comply with IEEE C57.12.29 for the paint coating system regardless of equipment material.

2.1.3 Load Interrupting Switched Ways

Provide the following for load interrupter switched ways:

- a. Three-pole group operated switching.
- b. Interrupter switches operated by means of an externally accessible switch-operating hub.
- c. Switch-operating hub located within a recessed stainless steel pocket mounted on the side of the pad-mounted gear enclosure.
- d. Padlockable stainless steel access cover and hood on the switch-operating-hub pocket to protect the padlock shackle from tampering.
- e. Stops on the switch-operating hub to prevent overtravel.
- f. Labels in the switch-operating-hub pocket to indicate switch position.
- g. Folding switch-operating handle for each interrupter switch.

2.1.4 Fused Ways

Provide the following:

- a. Fuse mountings enclosed in an inner steel compartment.
- b. Each fuse mounting installed as an integral part of a fuse handling mechanism that does not allow access to the fuse until the elbow for that fuse has been disconnected and a mechanical interlock to the fuse-access panel has been actuated.
- c. The opening into the component compartment covered by the fuse-access panel in both the open and closed positions to prevent access to high voltage.
- d. Blown-fuse indicators for fused ways visible through viewing windows in the termination compartment.

2.1.4.1 Fuses

Provide fuses in accordance with the following:

- a. Fuse ratings as indicated.
- b. Helically coiled fuses if rated 10 amperes or larger.
- c. Solid-material power fuses capable of detecting and interrupting all faults under all realistic conditions of circuitry, with line-to-line or line-to-ground voltage across the fuse, and capable of handling the full range of transient recovery voltage severity associated with these faults.
- d. All arcing accompanying operation of the fuse contained within the fuse, and all arc products and gases evolved effectively contained within the exhaust control device during fuse operation.
- e. Fusible elements nonaging and nondamagable with melting time-current characteristics that are permanently accurate to within a maximum tolerance of 10percent in terms of current.
- f. Equipped with a blown-fuse indicator that provides visible evidence of fuse operation while installed in the fuse mounting.

2.1.5 Dead-Front High-Voltage Bushings

IEEE 386. 15 kV, 95 kV BIL. Provide 600 ampere one-piece deadbreak apparatus bushings for each switched way.

- a. Parking stands: Provide a parking stand near each dead-front bushing.

2.2 Insulated High-Voltage Connectors

IEEE 386. Provide corresponding connector for each switched way; provide connectors with a grounding eye and test point.

- a. 600 Ampere deadbreak connector ratings: Voltage: 15 kV, 95 kV BIL. Short time rating: 25,000 rms symmetrical amperes.

2.3 Surge Arresters

IEEE C62.11, rated as indicated, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for

plugging into inserts. Provide arresters on switched ways as indicated.

2.4 Grounding Provisions

Provide a ground-connection pad in each termination compartment. Provide a continuous copper ground bus across the full width of each termination compartment for fuses.

2.5 Faulted Circuit Indicators

Install one set of faulted circuit indicators on the test points of each set of separable insulated connectors. Faulted circuit indicators must comply with IEEE 495. Indicators must be self powered; with automatic trip with mechanical flag indication upon overcurrent followed by loss of system voltage. Indicators must be compact, sealed corrosion resistant construction with provision for hotstick installation and operation.

2.6 SOURCE QUALITY CONTROL

2.6.1 Switchgear Design and Production Tests

Furnish reports which include results of design and production tests performed according to IEEE C37.74. Perform production tests by the manufacturer on each switchgear assembly to ensure that design performance is maintained in production.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.2 GROUNDING

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 25 ohms. When work, in addition to that indicated or specified, is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" applies.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION at each corner of switchgear pad as indicated.

3.2.2 Switchgear Grounding

Connect #4/0 bare copper conductor ground loop, not less than 24 inches below grade, to the upper end of the ground rods by exothermic welds or compression connectors. Provide #4/0 bare copper conductors connecting the switchgear grounding provisions to grounding loop as indicated.

3.2.3 Connections

Make joints in grounding conductors and ground loop by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount switch on concrete slab as indicated.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with switch cable training areas. Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.4 FIELD QUALITY CONTROL

3.4.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS and referenced ANSI standards. Submit reports, including acceptance criteria and limits for each test in accordance with NETA ATS "Test Values".

Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.4.1.1 Switchgear

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate information with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Check for proper anchorage, alignment, required area clearances, and grounding.
- (4) Perform mechanical operator tests in accordance with manufacturer's instructions.
- (5) Inspect all indicating devices for proper operation.

b. Electrical Tests

- (1) Perform contact-resistance tests.
- (2) Perform insulation-resistance tests.
- (3) Perform an over-potential test on each switched way pole with the switched way in the open position in accordance with the manufacturer's instructions.

3.4.1.2 Grounding System

a. Visual and Mechanical Inspection

- (1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

- (1) Perform ground impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.
- (2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.4.2 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that devices are in good operating condition and properly performing the intended function. Perform each item not less than three times to demonstrate its function. As an exception to requirements stated elsewhere in the contract, notify the Contracting Officer 5 working days in advance of the dates and times for checks and tests.

3.5 Special Testing for Seismic-Resisting Equipment

Equipment is required to remain operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise. Seismic component qualification documentation for each piece of equipment must contain the information required in UFC 3-301-02, Section 2-17.2.5 Component Qualification Documentation. Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be less than 5 inches by 7 inches with red letters 1-inch in height on a white background stating "Certified Equipment". The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file". The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

3.6 Special Inspection for Seismic-Resisting Systems and Equipment

Perform special inspections for seismic-resisting systems, equipment and components for structures assigned to Risk Category IV per Section 01 45 35 SPECIAL INSPECTIONS.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM

08/19, CHG 1: 11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B633	(2019) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI C80.3	(2015) American National Standard for Electrical Metallic Tubing (EMT)
ANSI C80.5	(2015) American National Standard for Electrical Rigid Aluminum Conduit

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA FU 1	(2012) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 4	(2015) Application Guideline for Terminal Blocks
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA KS 1	(2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA MG 1	(2018) Motors and Generators
NEMA MG 10	(2017) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(2014) Dry-Type Transformers for General Applications
NEMA TC 2	(2020) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2016) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA VE 1	(2017) Metal Cable Tray Systems
NEMA WD 1	(1999; R 2015) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2016) Wiring Devices Dimensions Specifications
NEMA Z535.4	(2011; R 2017) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
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20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 70E (2021) Standard for Electrical Safety in
the Workplace

NFPA 780 (2017) Standard for the Installation of
Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568-C.1 (2009; Add 2 2011; Add 1 2012) Commercial
Building Telecommunications Cabling
Standard

TIA-569 (2015d) Commercial Building Standard for
Telecommunications Pathways and Spaces

TIA-607 (2015c; Addendum 1 2017) Generic
Telecommunications Bonding and Grounding
(Earthing) for Customer Premises

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 431 Energy Efficiency Program for Certain
Commercial and Industrial Equipment

29 CFR 1910.147 The Control of Hazardous Energy (Lock
Out/Tag Out)

29 CFR 1910.303 Electrical, General

UNDERWRITERS LABORATORIES (UL)

UL 1 (2005; Reprint Jan 2020) UL Standard for
Safety Flexible Metal Conduit

UL 4 (2004; Reprint Feb 2018) UL Standard for
Safety Armored Cable

UL 6 (2007; Reprint Sep 2019) UL Standard for
Safety Electrical Rigid Metal Conduit-Steel

UL 6A (2008; Reprint Sep 2019) UL Standard for
Safety Electrical Rigid Metal Conduit -
Aluminum, Red Brass, and Stainless Steel

UL 20 (2010; Reprint Feb 2012) General-Use Snap
Switches

UL 44 (2018; Reprint May 2021) UL Standard for
Safety Thermoset-Insulated Wires and Cables

UL 50 (2015) UL Standard for Safety Enclosures
for Electrical Equipment,
Non-Environmental Considerations

UL 67 (2018; Reprint Jul 2020) UL Standard for
Safety Panelboards

UL 83	(2017; Reprint Mar 2020) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 198M	(2018) UL Standard for Mine-Duty Fuses
UL 360	(2013; Reprint Oct 2020) UL Standard for Safety Liquid-Tight Flexible Metal Conduit
UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 486A-486B	(2018; Reprint May 2021) UL Standard for Safety Wire Connectors
UL 486C	(2019) UL Standard for Safety Splicing Wire Connectors
UL 489	(2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 498	(2017; Reprint Aug 2020) UL Standard for Safety Attachment Plugs and Receptacles
UL 506	(2017) UL Standard for Safety Specialty Transformers
UL 508	(2018) UL Standard for Safety Industrial Control Equipment
UL 510	(2020) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2013; Reprint Aug 2017) UL Standard for Safety Metallic Outlet Boxes
UL 514B	(2012; Reprint May 2020) Conduit, Tubing and Cable Fittings
UL 514C	(2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(2011; Reprint Mar 2020) UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL 674	(2011; Reprint Nov 2018) UL Standard for Safety Electric Motors and Generators for Use in Hazardous (Classified) Locations
UL 797	(2007; Reprint Mar 2017) UL Standard for Safety Electrical Metallic Tubing -- Steel
UL 817	(2015; Reprint May 2017) UL Standard for Safety Cord Sets and Power-Supply Cords

UL 854	(2020) Standard for Service-Entrance Cables
UL 869A	(2006; Reprint Jun 2020) Reference Standard for Service Equipment
UL 943	(2016; Reprint Feb 2018) UL Standard for Safety Ground-Fault Circuit-Interrupters
UL 984	(1996; Reprint Sep 2005) Hermetic Refrigerant Motor-Compressors
UL 1063	(2017) UL Standard for Safety Machine-Tool Wires and Cables
UL 1203	(2013; Reprint Jan 2020) UL Standard for Safety Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
UL 1242	(2006; Reprint Aug 2020) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1449	(2014; Reprint Jul 2017) UL Standard for Safety Surge Protective Devices
UL 1561	(2011; Reprint Jun 2015) Dry-Type General Purpose and Power Transformers
UL 1660	(2019) Liquid-Tight Flexible Nonmetallic Conduit
UL 4248-1	(2017) UL Standard for Safety Fuseholders - Part 1: General Requirements
UL 4248-12	(2018) UL Standard for Safety Fuseholders - Part 12: Class R

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE 100.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Panelboards; G

Transformers; G

Cable Trays; G

Marking Strips Drawings; G

SD-03 Product Data

Receptacles; G

Circuit Breakers; G

Switches; G

Transformers; G

Enclosed Circuit Breakers; G

Motor Controllers; G

Manual Motor Starters; G

CATV Outlets; G

Telecommunications Grounding Busbar; G

Surge Protective Devices; G

SD-06 Test Reports

600-volt Wiring Test; G

Grounding System Test; G

Transformer Tests; G

Ground-fault Receptacle Test; G

SD-07 Certificates

Fuses; G

SD-09 Manufacturer's Field Reports

Transformer Factory Tests

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5; G

1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.4.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of

similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with NFPA 70 unless more stringent requirements are specified or indicated.

1.4.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.5 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein. Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. Include the following:

- a. Single line diagram of the "as-built" building electrical system.
- b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).
- c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

Provide equipment items supported by service organizations that are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

As a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70 for all materials, equipment, and devices.

2.2 CONDUIT AND FITTINGS

Conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

ANSI C80.1, UL 6.

2.2.1.2 Rigid Aluminum Conduit

ANSI C80.5, UL 6A.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2, UL 651.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, ANSI C80.3.

2.2.5 Plastic-Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40(40 mils thick).

2.2.6 Flexible Metal Conduit

UL 1.

2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings: cadmium- or zinc-coated in accordance with UL 514B.

2.2.7.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT

Steel compression type.

2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.2.9 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.2.10 Conduit Bodies

UL File No. E-150222.

2.2.10.1 Conduit Bodies for Telecommunications

Bend radii of cables is maintained per ANSI/TIA/EIA 568 and NECA/FOA.

2.3 CABLE TRAYS

NEMA VE 1. Provide the following:

- a. Cable trays: form a wireway system, with a nominal depth as indicated.
- b. Cable trays: constructed of aluminum or steel.
- c. Cable trays: include splice and end plates, dropouts, and miscellaneous hardware.
- d. Edges, fittings, and hardware: finished free from burrs and sharp edges.
- e. Fittings: ensure not less than load-carrying ability of straight tray sections and have manufacturer's minimum standard radius.
- f. UL listed

2.3.1 Basket-Type Cable Trays

Constructed of high strength 0.196 inch steel wire meeting ASTM 510, Grade 1008. Provide with a electro-plated zinc galvanized finish meeting ASTM B633, Type III, SC-1. Provide size as indicated with maximum wire mesh spacing of 2 by 4 inch.

2.3.2 Runway-Type Cable Trays

Constructed of 3/8 inch x 1-1/2 inch x .065 inch wall rectangular steel tubing powder coated black. Provide size as indicated with maximum rung spacing of 12 inches.

2.4 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.4.1 Floor Outlet Boxes

Provide the following:

Steel, multi-gang construction designed to work in concrete or raised floors applications; provide number of gangs as indicated on drawings.

Box is fully adjustable both pre and post concrete pour. Box is versatile with the ability to add or remove dividers and a tunnel feature which allows multiple gangs to be connected for added cable capacity. Knockout for conduit sizes ranging from 3/4 inch to 2 inch. Cover is to have a full articulating 180 degree cover. Cover is to also have egress cable door for passing of cables when cover is closed. Cover shall be a surface style cover with carpet insert. Box is capable of accepting standard size wall plates. Provide accessories as required to furnish devices indicated on drawings.

a. Boxes: adjustable and concrete tight.

2.4.2 Outlet Boxes for Telecommunications System

16 Gauge welded steel box with a galvanized coating. Box has 1 inch and 1-1/4 inch knockouts on sides and 1/2 inch and 3/4 inch knockouts in bottom. Box is provided with #8-32 mounting provisions. Provide with single gang mud-ring as required for recessed drywall installation. Box size as indicated on drawings.

2.5 CABINETS, JUNCTION BOXES, AND PULL BOXES

UL 50; volume greater than 100 cubic inches, NEMA Type 1 enclosure; sheet steel, hot-dip, zinc-coated. Where exposed to wet, damp, or corrosive environments, NEMA Type as indicated.

2.6 WIRES AND CABLES

Provide wires and cables in accordance applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Do not use wires and cables manufactured more than 12 months prior to date of delivery to site.

2.6.1 Conductors

Provide the following:

- a. Conductor sizes and capacities shown are based on copper.
- b. Conductors No. 8 AWG and larger diameter: stranded.
- c. Conductors No. 10 AWG and smaller diameter: solid.
- d. Conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3: stranded unless specifically indicated otherwise.
- e. All conductors: copper.

2.6.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.6.1.2 Minimum Conductor Sizes

Provide minimum conductor size in accordance with the following:

- a. Branch circuits: No. 12 AWG.

- b. Class 1 remote-control and signal circuits: No. 14 AWG.
- c. Class 2 low-energy, remote-control and signal circuits: No. 16 AWG.
- d. Class 3 low-energy, remote-control, alarm and signal circuits: No. 22 AWG.
- e. Digital low voltage lighting control (DLVLC) system at 24 Volts or less: Category 5 UTP cables in accordance with DLVLC system manufacturer requirements.

2.6.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

2.6.2.1 Ground and Neutral Conductors

Provide color coding of ground and neutral conductors as follows:

- a. Grounding conductors: Green.
- b. Neutral conductors: White.
- c. Exception, where neutrals of more than one system are installed in same raceway or box, other neutrals color coding: white with a different colored (not green) stripe for each.

2.6.2.2 Ungrounded Conductors

Provide color coding of ungrounded conductors in different voltage systems as follows:

- a. 208/120 volt, three-phase
 - (1) Phase A - black
 - (2) Phase B - red
 - (3) Phase C - blue
- b. 480/277 volt, three-phase
 - (1) Phase A - brown
 - (2) Phase B - orange
 - (3) Phase C - yellow
- c. On three-phase, four-wire delta system, high leg: orange, as required by NFPA 70.

2.6.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, provide power and lighting wires rated for 600-volts, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits: Type TW or TF, conforming to UL 83.

Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.6.4 Bonding Conductors

ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.6.4.1 Telecommunications Bonding Backbone (TBB)

Provide insulated TBB with insulation as specified in the paragraph INSULATION and meeting the fire ratings of its pathway.

2.6.4.2 Bonding Conductor for Telecommunications

Provide a copper conductor Bonding Conductor for Telecommunications between the telecommunications main grounding busbar and the electrical service ground in accordance with TIA-607. Size the bonding conductor for telecommunications the same as the TBB.

2.6.5 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

2.6.6 Armored Cable

UL 4; NFPA 70, Type AC cable.

2.6.7 Cord Sets and Power-Supply Cords

UL 817.

2.7 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires: insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.8 DEVICE PLATES

Provide the following:

- a. UL listed, one-piece device plates for outlets to suit the devices installed.
- b. For metal outlet boxes, plates on unfinished walls: zinc-coated sheet steel or cast metal having round or beveled edges.
- c. For nonmetallic boxes and fittings, other suitable plates may be provided.
- d. Plates on finished walls: nylon or lexan, minimum 0.03 inch wall thickness and same color as receptacle or toggle switch with which they are mounted.
- e. Screws: machine-type with countersunk heads in color to match finish

of plate.

- f. Sectional type device plates are not be permitted.
- g. Plates installed in wet locations: gasketed and UL listed for "wet locations."

2.9 SWITCHES

2.9.1 Toggle Switches

NEMA WD 1, UL 20, single pole, three-way, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Include the following:

- a. Handles: white thermoplastic.
- b. Wiring terminals: screw-type, side-wired.
- c. Contacts: silver-cadmium and contact arm - one-piece copper alloy.
- d. Switches: rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.9.2 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Utilize Class R fuseholders and fuses for fused switches, unless indicated otherwise. Provide horsepower rated for switches serving as the motor-disconnect means. Provide switches in NEMA, enclosure as indicated per NEMA ICS 6.

2.10 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch. Coordinate time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices for proper operation. Submit coordination data for approval. Provide fuses with a voltage rating not less than circuit voltage.

2.10.1 Fuseholders

Provide in accordance with UL 4248-1.

2.10.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 198M, Class RK-1. Provide only Class R associated fuseholders in accordance with UL 4248-12.

2.10.3 Cartridge Fuses, High-Interrupting Capacity, Current Limiting Type (Classes J, L, and CC)

UL 198M, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.

2.10.4 Cartridge Fuses, Current Limiting Type (Class T)

UL 198M, Class T for zero to 1,200 amperes, 300 volts; and zero to 800

amperes, 600 volts.

2.11 RECEPTACLES

Provide the following:

- a. UL 498, general purpose specification grade, grounding-type. Residential grade receptacles are not acceptable.
- b. Ratings and configurations: as indicated.
- c. Bodies: white as per NEMA WD 1.
- d. Face and body: thermoplastic supported on a metal mounting strap.
- e. Dimensional requirements: per NEMA WD 6.
- f. Screw-type, side-wired wiring terminals or of the solderless pressure type having suitable conductor-release arrangement.
- g. Grounding pole connected to mounting strap.
- h. The receptacle: containing triple-wipe power contacts and double or triple-wipe ground contacts.

2.11.1 Weatherproof Receptacles

Provide receptacles, UL listed for use in "wet locations". Include cast metal box with gasketed, hinged, lockable and weatherproof while-in-use, polycarbonate, UV resistant/stabilized cover plate.

2.11.2 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Provide device capable of detecting current leak when the current to ground is 6 milliamperes or higher, and tripping per requirements of UL 943 for Class A ground-fault circuit interrupter devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.11.3 Special Purpose Receptacles

Receptacles serving are special purpose. Provide in ratings indicated. NEMA configuration as indicated.

2.12 PANELBOARDS

Provide panelboards in accordance with the following:

- a. UL 67 and UL 50 having a short-circuit current rating as indicated.
- b. Panelboards for use as service disconnecting means: additionally conform to UL 869A.
- c. Panelboards: circuit breaker-equipped.
- d. Designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL.

- e. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings.
- f. Use of "Subfeed Breakers" is not acceptable.
- g. Main breaker: "separately" mounted "above" or "below" branch breakers.
- h. Where "space only" is indicated, make provisions for future installation of breakers.
- i. Directories: indicate load served by each circuit in panelboard.
- j. Directories: indicate source of service to panelboard (e.g., Panel PA served from Panel MDP).
- k. Type directories and mount in holder behind transparent protective covering.
- l. Panelboards: listed and labeled for their intended use.
- m. Panelboard nameplates: provided in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.12.1 Enclosure

Provide panelboard enclosure in accordance with the following:

- a. UL 50.
- b. Cabinets mounted outdoors or flush-mounted: hot-dipped galvanized after fabrication.
- c. Cabinets: painted in accordance with paragraph PAINTING.
- d. Outdoor cabinets: NEMA 4x with conduit hubs welded to the cabinet.
- e. Front edges of cabinets: form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front.
- f. All cabinets: fabricated such that no part of any surface on the finished cabinet deviates from a true plane by more than 1/8 inch.
- g. Holes: provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface.
- h. Flush doors: mounted on hinges that expose only the hinge roll to view when the door is closed.
- i. Each door: fitted with a combined catch and lock latch.
- j. Keys: two provided with each lock, with all locks keyed alike.
- k. Finished-head cap screws: provided for mounting the panelboard fronts on the cabinets.

2.12.2 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet. In addition to equipment grounding bus, provide second "isolated" ground bus, where indicated.

2.12.2.1 Panelboard Neutrals for Non-Linear Loads

Provide in accordance with the following:.

- a. UL listed, with panelboard type specifically UL heat rise tested for use on non-linear loads.
- b. Panelboard: heat rise tested in accordance with UL 67, except with the neutral assembly installed and carrying 200 percent of the phase bus current during testing.
- c. Verification of the testing procedure: provided upon request.
- d. Two neutral assemblies paralleled together with cable is not acceptable.
- e. Nameplates for panelboard rated for use on non-linear loads: marked "SUITABLE FOR NON-LINEAR LOADS" and in accordance with paragraph FIELD FABRICATED NAMEPLATES.
- f. Provide a neutral label with instructions for wiring the neutral of panelboards rated for use on non-linear loads.

2.12.3 Circuit Breakers

UL 489, thermal magnetic-type and solid state-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker will be mounted. Breaker terminals: UL listed as suitable for type of conductor provided. Where indicated on the drawings, provide circuit breakers with shunt trip devices. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.12.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.12.3.2 Circuit Breaker With Ground-Fault Circuit Interrupter

UL 943 and NFPA 70. Provide with auto-monitoring (self-test) and lockout features, "push-to-test" button, visible indication of tripped condition, and ability to detect and trip when current imbalance is 6 milliamperes or higher per requirements of UL 943 for Class A ground-fault circuit interrupter devices.

2.12.4 Lighting Control Panelboards

Provided a lighting control panelboard having the following features:

- a. Minimum sixteen schedules including a 7-day repeating schedule with sixteen daily on/off periods.
- b. Minimum sixteen lighting zones grouping branch breakers that are controlled by schedules, manual inputs, or override commands.
- c. Electronic clock including real-time, astronomical clock, and leap year and daylight savings time adjustments.
- d. Burn-hour tracking.
- e. Communications with building automation system using Modbus RTU protocol via RS-485 cable connection.

2.13 LOAD CENTERS FOR HOUSING UNITS

Provide single-phase panelboards for housing units on this project in accordance with the following:

- a. Load center type, circuit breaker equipped, conforming to UL 67 and UL 50.
- b. Panelboards series short-circuit current rating: 22,000 amperes symmetrical minimum for the main breaker and the branch breakers.
- c. Panelboards for use as service disconnecting means: additionally conform to UL 869A.
- d. Designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL.
- e. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings.
- f. Where "space only" is indicated, make provisions for future installation of breakers.
- g. Provide cover with latching door.
- h. Directories: indicate load served by each circuit in panelboard.
- i. Directories: indicate source of service to panelboard (e.g., Panel PA served from panel MDP)
- j. Type directories and mount behind in holder with transparent protective covering on inside of panel door.

2.13.1 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide copper or aluminum bus bars, either tin plated or silver plated. Provide isolated neutral bus in each panel for

connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.13.2 Circuit Breakers

UL 489 thermal magnetic type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker will be mounted. Breaker terminals: UL listed as suitable for type of conductor provided. Half-size and tandem breakers are not acceptable. Provide switch duty rated 15 and 20 ampere breakers. Breakers must not require use of panel trim to secure them to the bus.

2.13.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any two adjacent breaker poles are connected to Phases A and B respectively.

2.14 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated. Provide solid neutral.

2.15 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors, also called motor circuit protectors (MCPs): UL 508 and UL 489, and provided as shown. Provide MSCPs that consist of an adjustable instantaneous trip circuit breaker used only in conjunction with a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection. Rate MSCPs in accordance with the requirements of NFPA 70.

2.16 TRANSFORMERS

Provide transformers in accordance with the following:

- a. NEMA ST 20, general purpose, dry-type, self-cooled, ventilated.
- b. Provide transformers in NEMA 1 enclosure.
- c. Transformer insulation system:
 - (1) 220 degrees C insulation system for transformers 15 kVA and greater, with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C.
 - (2) 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 80 degrees C under full-rated load in maximum ambient of 40 degrees C.
- d. Transformer of 150 degrees C temperature rise is not acceptable.
- e. Transformer of 115 degrees C temperature rise: capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

- f. Transformer of 80 degrees C temperature rise: capable of carrying continuously 130 percent of nameplate kVA without exceeding insulation rating.
- g. Transformers: quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.16.1 Specified Transformer Efficiency

Transformers, indicated and specified with: 480V primary, 80 degrees C or 115 degrees C temperature rise, kVA ratings of 37.5 to 100 for single phase or 30 to 500 for three phase, energy efficient type. The transformer is not acceptable if the calculated transformer efficiency is less than the efficiency indicated in 10 CFR 431, Subpart K.

2.16.2 Transformers With Non-Linear Loads

Provide transformers for non-linear loads in accordance with the following:

- a. Transformer insulation: UL recognized 220 degrees C system. Neither the primary nor the secondary temperature is allowed to exceed 220 degrees C at any point in the coils while carrying their full rating of non-sinusoidal load.
- b. Transformers are to be UL listed and labeled for K-Factor rating as indicated in accordance with UL 1561.
- c. Transformers evaluated by the UL K-Factor evaluation: listed for 115 degrees C average temperature rise only.
- d. Transformers with K-Factor ratings with temperature rise of 150 degrees C rise are not acceptable.
- e. K-Factor rated transformers impedance: allowed range of 3 percent to 5 percent, with a minimum reactance of 2 percent to prevent excessive neutral current when supplying loads with large amounts of third harmonic.

2.17 MOTORS

Provide motors in accordance with the following:

- a. NEMA MG 1 except provide fire pump motors as specified in Section 21 30 00 FIRE PUMPS.
- b. Hermetic-type sealed motor compressors: Also comply with UL 984.
- c. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified.
- d. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters.
- e. Rate motors for operation on 208-volt, 3-phase circuits with a terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits with a terminal voltage rating of 460 volts.

- f. Use motors designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.
- g. Unless otherwise indicated, use continuous duty type motors if rated 1 HP and above.
- h. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

2.17.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors: high efficiency types are not acceptable. In exception, for special purpose motors and motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.17.2 Premium Efficiency Polyphase and Single-Phase Motors

Select polyphase and continuous-duty single phase motors based on high efficiency characteristics relative to typical characteristics and applications as listed in NEMA MG 10 and NEMA MG 11. In addition, continuous rated, polyphase squirrel-cage medium induction motors must meet the requirements for premium efficiency electric motors in accordance with NEMA MG 1, including the NEMA full load efficiency ratings. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.17.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.17.4 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment using adjustable speed drive (ASD) manufacturer required wiring type and length, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment as specified herein. Power wiring and conduit: conform to the requirements specified herein. Control wiring: provided under, and conform to, the requirements of the section specifying the associated equipment.

2.18 MOTOR CONTROLLERS

Provide motor controllers in accordance with the following:

- a. UL 508, NEMA ICS 1, and NEMA ICS 2, except fire pump controllers as specified in Section 21 30 00 FIRE PUMPS.
- b. Provide controllers with thermal overload protection in each phase, and one spare normally open auxiliary contact, and one spare normally closed auxiliary contact.
- c. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage.
- d. Provide protection for motors from immediate restart by a time adjustable restart relay.
- e. When used with pressure, float, or similar automatic-type or maintained-contact switch, provide a hand/off/automatic selector switch with the controller.
- f. Connections to selector switch: wired such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position.
- g. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices: connected in motor control circuit in "hand" and "automatic" positions.
- h. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device: made in accordance with indicated or manufacturer's approved wiring diagram.
- i. Provide a disconnecting means, capable of being locked in the open position, for the motor that is located in sight from the motor location and the driven machinery location. As an alternative, provide a motor controller disconnect, capable of being locked in the open position, to serve as the disconnecting means for the motor if it is in sight from the motor location and the driven machinery location.
- j. Overload protective devices: provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case.
- k. Cover of combination motor controller and manual switch or circuit breaker: interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.
- l. Minimum short circuit withstand rating of combination motor controller: 10,000 rms symmetrical amperes.

2.18.1 Control Wiring

Provide control wiring in accordance with the following:

- a. All control wire: stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44, or Type

MTW meeting UL 1063, and passing the VW-1 flame tests included in those standards.

- b. Hinge wire: Class K stranding.
- c. Current transformer secondary leads: not smaller than No. 10 AWG.
- d. Control wire minimum size: No. 14 AWG.
- e. Power wiring for 480-volt circuits and below: the same type as control wiring with No. 12 AWG minimum size.
- f. Provide wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.18.2 Control Circuit Terminal Blocks

Provide control circuit terminal blocks in accordance with the following:

- a. NEMA ICS 4.
- b. Control circuit terminal blocks for control wiring: molded or fabricated type with barriers, rated not less than 600 volts.
- c. Provide terminals with removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts.
- d. Terminals: not less than No. 10 in size with sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal.
- e. Terminal arrangement: subject to the approval of the Contracting Officer with not less than four spare terminals or 10 percent, whichever is greater, provided on each block or group of blocks.
- f. Modular, pull apart, terminal blocks are acceptable provided they are of the channel or rail-mounted type.
- g. Submit data showing that any proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.18.2.1 Types of Terminal Blocks

- a. Short-Circuiting Type: Short-circuiting type terminal blocks: furnished for all current transformer secondary leads with provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks: comply with the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.
- b. Load Type: Load terminal blocks rated not less than 600 volts and of adequate capacity: provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits, except those for feeder tap units. Provide terminals of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated

more than 50 amperes, provide screws with hexagonal heads. Conducting parts between connected terminals must have adequate contact surface and cross-section to operate without overheating. Provide each connected terminal with the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.18.3 Control Circuits

Control circuits: maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers: conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits: provide primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. Provide one fused secondary lead with the other lead grounded.

2.18.4 Enclosures for Motor Controllers

NEMA ICS 6.

2.18.5 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers: include compelling relays and multiple-button, station-type with pilot lights for each speed.

2.18.6 Reduced-Voltage Controllers

Provide for polyphase motors 10 HP horsepower and larger. Reduced-voltage starters: single-step, closed transition solid state-type, or as indicated, with an adjustable time interval between application of reduced and full voltages to motors.

2.19 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Poles as indicated designed for surface mounting with overload protection.

2.20 LOCKOUT REQUIREMENTS

Provide circuit breakers, disconnecting means, and other devices that are electrical energy-isolating capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147, NFPA 70E and 29 CFR 1910.303. Comply with requirements of Division 23, "Mechanical" for mechanical isolation of machines and other equipment.

2.21 TELECOMMUNICATIONS SYSTEM

See telecommunications requirements are specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.22 COMMUNITY ANTENNA TELEVISION (CATV) SYSTEM

Additional CATV requirements are specified in Section 27 05 13.43 TELEVISION DISTRIBUTION SYSTEM.

2.22.1 CATV Outlets

Provide flush mounted, 75-ohm, F-type connector outlet rated from 5 to 1000 MHz in standard electrical outlet boxes with mounting frame.

2.22.2 CATV Faceplates

Provide modular faceplates for mounting of CATV Outlets. Faceplate color: match outlet and switch coverplates.

2.22.3 Backboards

Provide void-free, fire rated interior grade plywood, 3/4 inch thick, as indicated. Do not cover the fire stamp on the backboard. Coordinate CATV backboard requirements with telecommunications backboard requirements as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING.

2.23 GROUNDING AND BONDING EQUIPMENT

2.23.1 Ground Rods

UL 467. Ground rods: cone pointed solid copper, with minimum diameter of 3/4 inch and minimum length 10 feet. Sectional ground rods are permitted.

2.23.2 Ground Bus

Copper ground bus: provided in the electrical equipment rooms as indicated.

2.23.3 Telecommunications and CATV Grounding Busbar

Provide corrosion-resistant grounding busbar suitable for indoor and for outdoor when indicated on the drawings installation in accordance with TIA-607. Busbars: plated for reduced contact resistance. If not plated, clean the busbar prior to fastening the conductors to the busbar and apply an anti-oxidant to the contact area to control corrosion and reduce contact resistance. Provide a Primary Bonding Bus (PBB) in the telecommunications entrance facility and a (SBB) in all other telecommunications rooms and equipment rooms. The Primary Bonding Buss (PBB) and the telecommunications grounding busbar (SBB): sized in accordance with the immediate application requirements and with consideration of future growth. Provide telecommunications grounding busbars with the following:

- a. Predrilled copper busbar provided with holes for use with standard sized lugs,
- b. Minimum dimensions of 0.25 in thick by 4 in wide for the PBB and 2 in wide for TGBs with length as required;
- c. Listed by a nationally recognized testing laboratory.

2.24 HAZARDOUS LOCATIONS

Electrical materials, equipment, and devices for installation in hazardous locations, as defined by NFPA 70: specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Boundaries and classifications of hazardous locations: as indicated. Equipment in

hazardous locations: comply with UL 1203 for electrical equipment and industrial controls and UL 674 for motors.

2.25 MANUFACTURER'S NAMEPLATE

Provide on each item of equipment a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.26 FIELD FABRICATED NAMEPLATES

Provide field fabricated nameplates in accordance with the following:

- a. ASTM D709.
- b. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.
- c. Each nameplate inscription: identify the function and, when applicable, the position.
- d. Nameplates: melamine plastic, 0.125 inch thick, white with black center core.
- e. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.
- f. Minimum size of nameplates: one by 2.5 inches.
- g. Lettering size and style: a minimum of 0.25 inch high normal block style.

2.27 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA Z535.4 for switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. Provide marking that is clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.28 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00 FIRESTOPPING.

2.29 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices (SPD) which comply with UL 1449 at the service entrance, panelboards, and switchboards as indicated on the construction drawing. Provide surge protectors in a NEMA 1 enclosure per NEMA ICS 6. SPD must have the same short-circuit current rating as the protected equipment and shall not be installed at a point of system where the available fault current is in excess of that rating. Use

Type 1 or Type 2 SPD and connect on the load side of a dedicated circuit breaker. Submit performance and characteristic curves.

Provide the following modes of protection:

FOR SINGLE PHASE AND THREE PHASE WYE CONNECTED SYSTEMS-

Phase to phase (L-L)
Each phase to neutral (L-N)
Neutral to ground (N-G)
Phase to ground (L-G)

SPDs at the service entrance: provide with a minimum surge current rating of 80,000 amperes for L-L mode minimum and 40,000 amperes for other modes (L-N, L-G, and N-G) and downstream SPDs rated 40,000 amperes for L-L mode minimum and 20,000 amperes for other modes (L-N, L-G, and N-G).

Provide SPDs. Maximum L-N, L-G, and N-G Voltage Protection Rating:

700V for 120V, single phase system
700V for 208Y/120V, three phase system
1,200V for 480Y/277V, three phase system

Maximum L-L Voltage Protection Rating:

1,200V for 208Y/120V, three phase system
2,000V for 480Y/277V, three phase system

The minimum MCOV (Maximum Continuous Operating Voltage) rating for L-N and L-G modes of operation: 120 percent of nominal voltage for 240 volts and below; 115 percent of nominal voltage above 240 volts to 480 volts.

2.30 FACTORY APPLIED FINISH

Provide factory-applied finish on electrical equipment in accordance with the following:

- a. NEMA 250 corrosion-resistance test and the additional requirements as specified herein.
- b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.
- c. Exterior surfaces: free from holes, seams, dents, weld marks, loose scale or other imperfections.
- d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.
- e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.
- f. Equipment located indoors: ANSI Light Gray, and equipment located outdoors: ANSI Light Gray.
- g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.31 SOURCE QUALITY CONTROL

2.31.1 Transformer Factory Tests

Submittal: include routine NEMA ST 20 transformer test results on each transformer and also provide the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces: conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit: continuous from service entrance equipment to outdoor power system connection.

3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures: labeled and identified as such.

3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, label each enclosure, new and existing, as one of several enclosures containing service entrance disconnect devices. Label, at minimum: indicate number of service disconnect devices housed by enclosure and indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure: provided only as permitted by NFPA 70.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Shared neutral, or multi-wire branch circuits, are not permitted with arc-fault circuit interrupters. Minimum conduit size: 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings: made with metal conduit in fire-rated shafts, with metal conduit extending through shafts for minimum distance of 6 inches. Firestop conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors in accordance with Section 07 84 00 FIRESTOPPING.

3.1.3.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum

200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.4 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. All exterior conduit and non-concealed conduit exposed to exterior environment i.e. rooms whose doors open to outside environments and have non-concealed conduit shall have an anti-corrosive industrial coating applied.

3.1.4.1 Restrictions Applicable to Aluminum Conduit

- a. Do not install underground or encase in concrete or masonry.
- b. Do not use brass or bronze fittings.
- c. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.4.2 Restrictions Applicable to EMT

- a. Do not install underground.
- b. Do not encase in concrete, mortar, grout, or other cementitious materials.
- c. Do not use in areas subject to physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.
- d. Do not use in hazardous areas.
- e. Do not use outdoors.
- f. Do not use in fire pump rooms.
- g. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.4.3 Restrictions Applicable to Nonmetallic Conduit

- a. PVC Schedule 40.
 - (1) Do not use where subject to physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, fire pump rooms, and where restrictions are applying to both PVC Schedule 40 and PVC Schedule 80.
 - (2) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.
- b. PVC Schedule 40 and Schedule 80.
 - (1) Do not use where subject to physical damage, including but not

limited to, hospitals, power plant, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

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3.1.4.4 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.4.5 Underground Conduit

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40
Plastic coating: extend minimum 6 inches above floor.

3.1.4.6 Conduit for Circuits Rated Greater Than 600 Volts

Rigid metal conduit or IMC only.

3.1.4.7 Conduit Installed Under Floor Slabs

Conduit run under floor slab: located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.4.8 Conduit Through Floor Slabs

Where conduits rise through floor slabs, do not allow curved portion of bends to be visible above finished slab. Where conduit rises through slab-on grade, seal all electrical penetrations to address radon mitigation and prevent infiltration of air, insects, and vermin.

3.1.4.9 Conduit Installed in Concrete Floor Slabs

Rigid steel; steel IMC. Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends must not be visible above finish slab. Increase slab thickness as necessary to provide minimum one inch cover over conduit. Where embedded conduits cross building expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings must allow horizontal and vertical movement of raceway. Conduit larger than one inch trade size: installed parallel with or at right angles to main reinforcement; when at right angles to reinforcement, install conduit close to one of supports of slab. Where nonmetallic conduit is used, convert raceway to plastic coated rigid steel or plastic coated steel IMC before rising above floor, unless specifically indicated.

3.1.4.10 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install

screwdriver-operated threaded flush plugs in conduit end.

3.1.4.11 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Do not exceed one-fourth proof test load for load applied to fasteners. Provide vibration resistant and shock-resistant fasteners attached to concrete ceiling. Do not cut main reinforcing bars for any holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems: supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Do not share supporting means between electrical raceways and mechanical piping or ducts. Coordinate installation with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 10 foot maximum intervals. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.4.12 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.13 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Provide locknuts with sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.14 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size: 1/2 inch diameter. Provide liquid tight flexible conduit in wet and damp locations and in fire pump rooms for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.4.15 Telecommunications and Signal System Pathway

Install telecommunications pathway in accordance with TIA-569.

- a. Horizontal Pathway: Telecommunications pathways from the work area to the telecommunications room: installed and cabling length requirements in accordance with TIA-568-C.1. Size conduits, wireways, and cable trays in accordance with TIA-569 and as indicated.
- b. Backbone Pathway: Telecommunication pathways from the telecommunications entrance facility to telecommunications rooms, and, telecommunications equipment rooms (backbone cabling): installed in accordance with TIA-569. Size conduits, wireways, and cable trays for telecommunications risers in accordance with TIA-569 and as indicated.

3.1.4.16 Community Antenna Television (CATV) System Conduits

Install a system of CATV wire-supporting structures (pathway), including: outlet boxes, conduits with pull wires wireways, cable trays, and other accessories for CATV outlets and pathway in accordance with TIA-569.

3.1.5 Cable Tray Installation

Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Support at maximum 6 foot intervals. In addition, install and ground telecommunications cable tray in accordance with TIA-569, and TIA-607 Ensure edges, fittings, and hardware are finished free from burrs and sharp edges. Provide No. 2 AWG bare copper wire throughout cable tray system, and bond to each section. Use No. 1/0 aluminum wire if cable tray is aluminum. Install conductors that run through smoke and fire partitions in 4 inch rigid steel conduits with grounding bushing, extending 12 inches beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.6 Telecommunications Cable Support Installation

Install open top and closed ring cable supports on 4 ft to 5 ft centers to adequately support and distribute the cable's weight. Use these types of supports to support a maximum of 50 0.25 in diameter cables. Install suspended cables with at least 3 in of clear vertical space above the ceiling tiles and support channels (T-bars). Open top and closed ring cable supports: suspended from or attached to the structural ceiling or walls with hardware or other installation aids specifically designed to support their weight.

3.1.7 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways: cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, and when specifically indicated. Boxes in other locations: sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit system. Provide each box with volume required by NFPA 70 for number of conductors enclosed in box.

Boxes for mounting lighting fixtures: minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls: square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; provide readily removable fixtures for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.7.1 Boxes

Boxes for use with raceway systems: minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets: minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Telecommunications outlets: a minimum of 5 inches square by 2 7/8 inches deep. Mount outlet boxes flush in finished walls.

3.1.7.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.7.3 Extension Rings

Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.8 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor. Mount receptacles 18 inches above finished floor, unless otherwise indicated. Mount other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.9 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter,

provide color coding by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. Provide telecommunications system conductor identification as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS.

3.1.9.1 Marking Strips

Provide marking strips for identification of power distribution, control, data, and communications cables in accordance with the following:

- a. Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations.
- b. Use permanent ink for the wire numbers
- c. Provide reversible marking strips to permit marking both sides, or provide two marking strips with each block.
- d. Size marking strips to accommodate the two sets of wire numbers.
- e. Assign a device designation in accordance with NEMA ICS 1 to each device to which a connection is made. Mark each device terminal to which a connection is made with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams.
- f. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations.
- g. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.10 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.11 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.12 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.13 Grounding and Bonding

Provide in accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, access flooring support system, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Bond additional driven rods together with a minimum of 4 AWG soft bare copper wire buried to a depth of at least 12 inches. Interconnect all grounding media in or on the structure to provide a common ground potential. This includes lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems. Make interconnection to the gas line on the customer's side of the meter. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA-607. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.13.1 Ground Rods

Provide ground rods and measure the resistance to ground using the fall-of-potential method described in IEEE 81. Do not exceed 25 ohms under normally dry conditions for the maximum resistance of a driven ground. If this resistance cannot be obtained with a single rod, provide additional rods, spaced on center. Spacing for additional rods must be a minimum of 10 feet. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

3.1.13.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic weld or high compression connector.

- a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.
- b. Make high compression connections using a hydraulic or electric compression tool to provide the correct circumferential pressure. Provide tools and dies as recommended by the manufacturer. Use an

embossing die code or other standard method to provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.13.3 Ground Bus

Provide a copper ground bus in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment: effectively grounded by bonding to the ground bus. Bond the ground bus to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Make connections and splices of the brazed, welded, bolted, or pressure-connector type, except use pressure connectors or bolted connections for connections to removable equipment.

3.1.13.4 Resistance

Maximum resistance-to-ground of grounding system: do not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.13.5 Telecommunications System

Provide telecommunications grounding in accordance with the following:

- a. Telecommunications Grounding Busbars: Provide a Primary Bonding Bus (PBB) in the telecommunications entrance facility. Install the PBB as close to the electrical service entrance grounding connection as practicable. Provide a Secondary Bonding Bus (SBB) in all other telecommunications rooms and telecommunications equipment rooms. Install the SBB as close to the telecommunications room panelboard as practicable, when equipped. Where a panelboard for telecommunications equipment is not installed in the telecommunications room, locate the SBB near the backbone cabling and associated terminations. In addition, locate the TGB to provide for the shortest and straightest routing of the grounding conductors. Where a panelboard for telecommunications equipment is located within the same room or space as a SBB, bond that panelboard's alternating current equipment ground (ACEG) bus (when equipped) or the panelboard enclosure to the TGB. Install telecommunications grounding busbars to maintain clearances as required by NFPA 70 and insulated from its support. A minimum of 2 inches separation from the wall is recommended to allow access to the rear of the busbar and adjust the mounting height to accommodate overhead or underfloor cable routing.
- b. Telecommunications Bonding Conductors: Provide main telecommunications service equipment ground consisting of separate bonding conductor for telecommunications, between the PBB and readily accessible grounding connection of the electrical service. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in ferrous metallic conduit that exceeds 3 feet in length, bond the conductors to each end of the conduit using a grounding bushing or a No. 6 AWG conductor, minimum. Provide a telecommunications bonding backbone (TBB) that originates at the PBB extends throughout the building using the telecommunications backbone pathways, and connects to the TGBs in all telecommunications rooms and equipment rooms. Install the TBB conductors such that they are protected from physical and mechanical damage. The TBB conductors should be installed without

splices and routed in the shortest possible straight-line path. Make the bonding conductor between a TBB and a TGB continuous. Where splices are necessary, the number of splices should be a minimum. Make the splices accessible and located in telecommunications spaces. Connect joined segments of a TBB using exothermic welding, irreversible compression-type connectors, or equivalent. Install all joints to be adequately supported and protected from damage. Whenever two or more TBBs are used within a multistory building, bond the TBBs together with a grounding equalizer (GE) at the top floor and at a minimum of every third floor in between. Do not connect the TBB and GE to the pathway ground, except at the PBB or the SBB.

- c. Telecommunications Grounding Connections: Telecommunications grounding connections to the PBB or SBB: utilize listed compression two-hole lugs, exothermic welding, suitable and equivalent one hole non-twisting lugs, or other irreversible compression type connections. Bond all metallic pathways, cabinets, and racks for telecommunications cabling and interconnecting hardware located within the same room or space as the PBB or SBB to the PBB or SBB respectively. In a metal frame (structural steel) building, where the steel framework is readily accessible within the room; bond each PBB and SBB to the vertical steel metal frame using a minimum No. 6 AWG conductor. Where the metal frame is external to the room and readily accessible, bond the metal frame to the SBB or PBB with a minimum No. 6 AWG conductor. When practicable because of shorter distances and, where horizontal steel members are permanently electrically bonded to vertical column members, the TGB may be bonded to these horizontal members in lieu of the vertical column members. All connectors used for bonding to the metal frame of a building must be listed for the intended purpose.

3.1.14 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications and are provided under the section specifying the associated equipment.

3.1.15 Elevator

Provide circuit to line terminals of elevator controller, and disconnect switch on line side of controller, outlet for control power, outlet receptacle and work light at midheight of elevator shaft, and work light and outlet receptacle in elevator pit.

3.1.16 Government-Furnished Equipment

Contractor rough-in for Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.17 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible. Maximum allowed lead length is 3 feet avoiding 90 degree bends.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting: as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.5.1 Devices Subject to Manual Operation

Operate each device subject to manual operation at least five times, demonstrating satisfactory operation each time.

3.5.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of 1,000 volts DC for 600 volt rated wiring and 500 volts DC for 300 volt rated wiring per NETA ATS to provide direct reading of resistance. All existing wiring to be reused shall also be tested.

3.5.3 Transformer Tests

Perform the standard, not optional, tests in accordance with the Inspection and Test Procedures for transformers, dry type, air-cooled, 600 volt and below; as specified in NETA ATS. Measure primary and secondary voltages for proper tap settings. Tests need not be performed by a recognized independent testing firm or independent electrical consulting firm.

3.5.4 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed. Press the TEST button and then the RESET button to verify by LED status that the device is a self-test model as specified in UL 943.

3.5.5 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not

earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

3.5.6 Phase Rotation Test

Perform phase rotation test to ensure proper rotation of service power prior to operation of new or reinstalled equipment using a phase rotation meter. Follow the meter manual directions performing the test.

-- End of Section --

SECTION 26 23 00

LOW-VOLTAGE SWITCHGEAR
05/15, CHG 2: 11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1 ((2014; Errata 2016) Electric Meters -
Code for Electricity Metering

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M (2020a) Standard Specification for
Chromium and Chromium-Nickel Stainless
Steel Plate, Sheet, and Strip for Pressure
Vessels and for General Applications

ASTM A780/A780M (2020) Standard Practice for Repair of
Damaged and Uncoated Areas of Hot-Dip
Galvanized Coatings

ASTM D149 (2020) Dielectric Breakdown Voltage and
Dielectric Strength of Solid Electrical
Insulating Materials at Commercial Power
Frequencies

ASTM D709 (2017) Standard Specification for
Laminated Thermosetting Materials

ASTM D1535 (2014; R 2018) Standard Practice for
Specifying Color by the Munsell System

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC ES AC156 (2012) Acceptable Criteria for Seismic
Certification by Shake-Table Testing of
Nonstructural Components

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81 (2012) Guide for Measuring Earth
Resistivity, Ground Impedance, and Earth
Surface Potentials of a Ground System

IEEE 100 (2000; Archived) The Authoritative
Dictionary of IEEE Standards Terms

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

IEEE C37.20.1A	(2020) Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit-Breaker Switchgear Amendment 1: Control and Secondary Circuits and Devices, and All Wiring
IEEE C37.20.7	(2017) Guide for Testing Switchgear Rated Up to 52 kV for Internal Arcing Faults
IEEE C37.90.1	(2013) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA LI 1	(1998; R 2011) Industrial Laminating Thermosetting Products
NEMA ST 20	(2014) Dry-Type Transformers for General Applications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
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U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-02	(2020) Design of Risk Category V Structures, National Strategic Military Assets
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UNDERWRITERS LABORATORIES (UL)

UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 1558	(2016; Reprint Nov 2019) UL Standard for Safety Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section,

with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE 100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchgear Drawings; G

SD-03 Product Data

Switchgear; G

SD-06 Test Reports

Switchgear Design Tests; G

Switchgear Production Tests; G

Acceptance Checks and Tests; G

SD-07 Certificates

Cybersecurity Equipment Certification; G

Submit certification indicating conformance with the paragraph CYBERSECURITY EQUIPMENT CERTIFICATION.

Cybersecurity Installation Certification; G

Submit certification indicating conformance with the paragraph CYBERSECURITY INSTALLATION CERTIFICATION.

SD-10 Operation and Maintenance Data

Switchgear Operation and Maintenance, Data Package 5; G

SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals; G

Equipment Test Schedule; G

Required Settings; G

1.5 QUALITY ASSURANCE

1.5.1 Product Data

Include manufacturer's information on each submittal for each component, device and accessory provided with the switchgear including:

- a. Circuit breaker type, interrupting rating, and trip devices, including available settings.
- b. Manufacturer's instruction manuals and published time-current curves (in electronic format) of the main secondary breaker and largest secondary feeder device.

1.5.2 Switchgear Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Identify circuit terminals on wiring diagrams and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate on the drawings adequate clearance for operation, maintenance, and replacement of operating equipment devices. Include the nameplate data, size, and capacity on submittal. Also include applicable federal, military, industry, and technical society publication references on submittals. Include the following:

- a. One-line diagram including breakers, fuses, current transformers, and meters.
- b. Outline drawings including front elevation, section views, footprint, and overall dimensions.
- c. Bus configuration including dimensions and ampere ratings of bus bars.
- d. Markings and NEMA nameplate data, including fuse information (manufacturer's name, catalog number, and ratings).
- e. Circuit breaker type, interrupting rating, and trip devices, including available settings.
- f. Wiring diagrams and elementary diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.
- g. Manufacturer's instruction manuals and published time-current curves (in electronic format) of the main secondary breaker and largest secondary feeder device. Use this information (designer of record) to provide breaker settings that ensures protection and coordination are achieved. For Navy installations, provide electronic format curves using SKM's Power Tools for Windows device library electronic format or EasyPower device library format depending on installation modeling software requirements.

1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "must" had been

substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site are not acceptable.

1.6 MAINTENANCE

1.6.1 Switchgear Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6.2 Assembled Operation and Maintenance Manuals

Assemble and securely bind manuals in durable, hard covered, water resistant binders. Assemble and index the manuals in the following order with a table of contents:

- a. Manufacturer's O&M information required by the paragraph SD-10, OPERATION AND MAINTENANCE DATA.
- b. Catalog data required by the paragraph SD-03, PRODUCT DATA.
- c. Drawings required by the paragraph SD-02, SHOP DRAWINGS.
- d. Prices for spare parts and supply list.

- e. Information on metering.
- f. Design test reports.
- g. Production test reports.

1.7 WARRANTY

Provide equipment items that are supported by service organizations reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

This specification section shall be used to specify the Shore Power 480V / 450V switchgear. The Industrial Power 480V switchboards shall be dictated by UFGS Section 26 24 13.

Products and materials not considered to be switchgear and related accessories are specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 SWITCHGEAR

IEEE C37.20.1A and UL 1558.

2.2.1 Ratings

Provide equipment with the following ratings:

- a. Voltage rating: as indicated.
- b. Continuous current rating of the main bus: as indicated.
- c. Short-circuit current rating: as indicated.
- d. UL listed and labeled as service entrance equipment.

2.2.2 Construction

Provide the following:

- a. Switchgear: consisting of vertical sections bolted together to form a rigid assembly and front and rear aligned.
- b. All circuit breakers: front accessible with rear load connections.
- c. Compartmentalized switchgear: vertical insulating barriers between the front device section, the main bus section, and the cable compartment with full front to rear vertical insulating barriers between adjacent sections.
- d. Where indicated, "space for future" or "space" means to include all necessary components and hardware to be fully equipped for racking in a circuit breaker element.

- e. Insulating barriers: provided in accordance with NEMA LI 1, Type GPO-3, 0.25 inch minimum thickness.
- f. Moisture resistant coating: applied to all rough-cut edges of barriers.
- g. Switchgear: Arc-resistant Type 1B, tested in accordance with IEEE C37.20.7.

2.2.2.1 Enclosure

Provide the following:

- a. Enclosure: outdoor NEMA ICS 6 Type 3R fabricated entirely of 12 gauge ASTM A240/A240M type 304 or 304L stainless steel.
- b. Enclosure: bolted together with removable bolt-on side and hinged rear covers, and sloping roof downward toward rear.
- c. Front doors: provided with stainless steel padlockable vault handles with a three point catch.
- d. Bases, frames and channels of enclosure: corrosion resistant and fabricated of ASTM A240/A240M type 304 or 304L stainless steel.
- e. Paint color: ASTM D1535 light gray No. 61 or No. 49 over rust inhibitor.
- f. Paint coating system: comply with IEEE C57.12.29 for stainless steel.

2.2.2.2 Bus Bars

Provide the following:

- a. Bus bars: copper with silver-plated contact surfaces.
 - (1) Phase bus bars: insulated with an epoxy finish coating powder or insulating sleeve providing a minimum breakdown voltage of 16,000 volts per ASTM D149.
- b. Make bus connections and joints with hardened steel bolts.
- c. Main-bus (through bus): rated at the full ampacity of the main throughout the switchgear.
- d. Minimum one-quarter by 2 inch copper ground bus secured to each vertical section along the entire length of the switchgear.

2.2.2.3 Main Section

Provide the main section consisting of an individually mounted drawout air power circuit breaker with current-limiting fuses and utility transformer compartment.

2.2.2.4 Distribution Sections

Provide the distribution sections consisting of individually mounted, drawout, air power circuit breakers with current-limiting fuses as indicated.

2.2.2.5 Handles

Coordinate lockout-tagout requirements with the Base's waterfront electrical department. Provide handles.

Provide handles for individually mounted devices of the same design and method of external operation. Label handles prominently to indicate device ampere rating, color coded for device type. Identify ON-OFF indication by handle position and by prominent marking.

2.2.3 Drawout Breakers

Equip drawout breakers with disconnecting contacts, wheels, and interlocks for drawout application. All breakers shall be electrically (motorized) operated for remote control from the Shore Power LVCB push buttons. Provide control cabling in conduit indicated on the drawings for the following functionality: breaker trip, breaker close. Provide indicating lights for each position that match the colors of the corresponding lights on the LVCB. Provide main, auxiliary, and control disconnecting contacts with silver-plated, multifinger, positive pressure, self-aligning type. Provide drawout compartment shutters to protect operators from accidental contact with breaker stabs when the breaker is withdrawn from its cubicle. Provide each drawout breaker with four-position operation with each position clearly identified by an indicator on the circuit breaker front panel as follows.

- a. Connected Position: Primary and secondary contacts are fully engaged. Breaker must be tripped before racking into or out of position.
- b. Test Position: Primary contacts are disconnected but secondary contacts remain fully engaged. This position allows complete test and operation of the breaker without energizing the primary circuit.
- c. Disconnected Position: Primary and secondary contacts are disconnected.
- d. Withdrawn (Removed) Position: Places breaker completely out of compartment, ready for removal. Removal of the breaker actuates assembly that isolates the primary stabs.

2.2.4 Electronic Trip Units

Equip main and distribution breakers with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that provides true rms sensing adjustable time-current circuit protection. Include the following:

- a. Current sensors ampere rating: the same as the breaker frame rating.
- b. Trip unit ampere rating: as indicated.
- d. Electronic trip units: provide additional features:
 - (1) Breakers: include long delay pick-up and time settings, and indication of cause of circuit breaker trip.
 - (2) Main breakers: include short delay pick-up and time settings,

instantaneous settings and ground fault settings.

- (3) Distribution breakers: include short delay pick-up and time settings and instantaneous settings.
- (4) Main Breakers: include a digital display for phase and ground current.
- (5) Main Breakers: include a digital display for watts, vars, VA, kWh, kvarh, and kVAh.

2.2.5 Protective Relays

Provide the following microelectronic relay(s) in the main and branch breakers to perform the following functionality:

- a. Under-voltage.
- b. Over-voltage.
- c. Under-frequency.

Provide all relays such that they have two (2) setpoints to allow for the unit substation transformers' secondary taps to be changed from 450V to 480V. Set point changes shall be activated by a single keyed switch located in the vicinity of the main circuit breaker.

2.2.6 Metering

2.2.6.1 Digital Meters

Provide digital meters for the main circuit breakers, and for each individual shore power receptacle circuit breaker.

IEEE C37.90.1 for surge withstand. Provide true rms, plus/minus one percent accuracy, programmable, microprocessor-based meter enclosed in a sealed case with the following features.

- a. Display capability:
 - (1) Multi-Function Meter: Display a selected phase to neutral voltage, phase to phase voltage, percent phase to neutral voltage THD, percent phase to phase voltage THD; a selected phase current, neutral current, percent phase current THD, percent neutral current; selected total PF, kW, KVA, kVAR, FREQ, kVAh, kWh. Detected alarm conditions include over/under current, over/under voltage, over/under KVA, over/under frequency, over/under selected PF/kVAR, voltage phase reversal, voltage imbalance, reverse power, over percent THD. Include a Form C KYZ pulse output relay on the meter.
- b. Design meters to accept input from standard 5A secondary instrument transformers and direct voltage monitoring range to 600 volts, phase to phase.
- c. Provide programming via a front panel display and a communication interface accessible by a computer.
- d. Provide password secured programming stored in non-volatile EEPROM

memory.

- e. Provide meter that calculates and stores average max/min demand values with time and date for all readings based on a user selectable sliding window averaging period.
- f. Provide meter with programmable hi/low set limits with two Form C dry contact relays when exceeding alarm conditions.
- g. Provide meter with a display of Total Harmonic Distortion (THD) measurement to a minimum of the thirty-first order.
- h. Include historical trend logging capability with the ability to store up to 100,000 data points with intervals of 1 second to 180 minutes. Provide a unit that can store and time stamp up to 1000 programmable triggered conditions.
- i. Provide event waveform recording triggered by the rms of 2 cycles of voltage or current exceeding programmable set points. Store waveforms for all 6 channels of voltage and current for a minimum of 10 cycles prior to the event and 50 cycles past the event.

2.2.7 Transformer

Provide transformer section in switchgear in accordance with UL 1558 and as indicated. Provide the transformer and section that is suitable for the installation. Provide a transformer conforming to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2.8 Heaters

Provide 120-volt heaters in each switchgear section. Provide heaters of sufficient capacity to control moisture condensation in the section, 250 watts minimum, and controlled by a thermostat and humidistat located in the section. Provide industrial type thermostat, high limit, to maintain sections within the range of 60 to 90 degrees F. Provide humidistat with a range of 30 to 60 percent relative humidity. Obtain supply voltage for the heaters from a control power transformer within the switchgear. If heater voltage is different than switchgear voltage, provide transformer rated to carry 125 percent of heater full load rating. Provide transformer with a 220 degrees C insulation system with a temperature rise not exceeding 115 degrees C and conforming to NEMA ST 20. Energize electric heaters in switchgear assemblies while the equipment is in storage or in place prior to being placed in service. Provide method for easy connection of heater to external power source. Provide temporary, reliable external power source if commercial power at rated voltage is not available on site.

2.2.9 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Provide short-circuiting type terminal boards associated with current transformer. Terminate conductors for current transformers with ring-tongue lugs. Provide terminal board identification that is identical in similar units. Provide color coded external wiring that is color coded consistently for similar terminal boards.

2.2.10 Wire Marking

Mark control and metering conductors at each end. Provide factory installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Provide a single letter or number on each sleeve, elliptically shaped to securely grip the wire, and keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Indicate on each wire marker the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.3 MANUFACTURER'S NAMEPLATE

Provide a nameplate on each item of equipment bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not acceptable. This nameplate and method of attachment may be the manufacturer's standard if it contains the required information.

2.4 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each switchgear, equipment enclosure, relay, switch, and device; as specified in this section or as indicated on the drawings. Identify on each nameplate inscription the function and, when applicable, the position. Provide nameplates of melamine plastic, 0.125 inch thick, white with black center core. Provide red laminated plastic label with white center core where indicated. Provide matte finish surface. Provide square corners. Accurately align lettering and engrave into the core. Provide nameplates with minimum size of one by 2.5 inches. Provide lettering that is a minimum of 0.25 inch high normal block style.

2.5 SOURCE QUALITY CONTROL

2.5.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

Provide the following as part of test equipment calibration:

- a. Provide a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
- b. Accuracy: Traceable to the National Institute of Standards and Technology.
- c. Instrument calibration frequency schedule: less than or equal to 12 months for both test floor instruments and leased specialty equipment.
- d. Dated calibration labels: visible on all test equipment.
- e. Calibrating standard: higher accuracy than that of the instrument

tested.

- f. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

- (1) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
- (2) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.5.2 Switchgear Design Tests

IEEE C37.20.1A and UL 1558.

2.5.2.1 Design Tests

Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

- a. Short-circuit current test.
- b. Enclosure tests.
- c. Dielectric test.

2.5.3 Switchgear Production Tests

IEEE C37.20.1A and UL 1558. Furnish reports which include results of production tests performed on the actual equipment for this project. These tests include:

- a. 60-hertz dielectric tests.
- b. Mechanical operation tests.
- c. Electrical operation and control wiring tests.
- d. Ground fault sensing equipment test.

2.5.4 Cybersecurity Equipment Certification

Furnish a certification that control systems are designed and tested in accordance with DoD Instruction 8500.01, DoD Instruction 8510.01, and as required by individual Service Implementation Policy.

2.6 ARC FLASH WARNING LABEL

Provide warning label for switchgear. Locate this self-adhesive warning label on the outside of the enclosure warning of potential electrical arc flash hazards and appropriate PPE required. Provide label format as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounds and grounding systems with a resistance to solid earth ground not exceeding 25 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of the ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Equipment Grounding

Provide bare copper cable not smaller than No. 4/0 AWG not less than 24 inches below grade connecting to the indicated ground rods. When work in addition to that indicated or specified is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" applies.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect equipment furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Switchgear

IEEE C37.20.1A.

3.3.2 Meters and Instrument Transformers

ANSI C12.1.

3.3.3 Field Applied Painting

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.3.4 Galvanizing Repair

Repair damage to galvanized coatings using ASTM A780/A780M, zinc rich paint, for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces that repair paint has been applied to.

3.3.5 Field Fabricated Nameplate Mounting

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.4.1 Exterior Location

Mount switchgear on concrete slab as follows:

- a. Unless otherwise indicated, provide the slab with dimensions at least 8 inches thick, reinforced with a 6 by 6 inch No. 6 mesh placed uniformly 4 inches from the top of the slab.
- b. Place slab on a 6 inch thick, well-compacted gravel base.
- c. Install slab such that the top of the concrete slab is approximately 4 inches above the finished grade.
- d. Provide edges above grade 1/2 inch chamfer.
- e. Provide slab of adequate size to project at least 8 inches beyond the equipment.
- f. Provide conduit turnups and cable entrance space required by the equipment to be mounted.
- g. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant.
- h. Cut off and bush conduits 3 inches above slab surface.
- i. Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.5 FIELD QUALITY CONTROL

Submit Required Settings of breakers to the Contracting Officer after approval of switchgear and at least 30 days in advance of their requirement.

3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Switchgear

- a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical, electrical, and mechanical condition.
- (3) Verify appropriate anchorage, required area clearances, and correct alignment.
- (4) Clean switchgear and verify shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.
- (5) Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.
- (6) Verify that fuse and circuit breaker sizes and types correspond to approved shop drawings as well as to the circuit breaker's address for microprocessor-communication packages.
- (7) Verify that current transformer ratios correspond to approved shop drawings.
- (8) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (9) Confirm correct operation and sequencing of electrical and mechanical interlock systems.
- (10) Confirm correct application of manufacturer's recommended lubricants.
- (11) Inspect insulators for evidence of physical damage or contaminated surfaces.
- (12) Verify correct barrier and shutter installation and operation.
- (13) Exercise all active components.
- (14) Inspect all mechanical indicating devices for correct operation.
- (15) Verify that filters are in place and vents are clear.
- (16) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.
- (17) Inspect control power transformers.

b. Electrical Tests

- (1) Perform insulation-resistance tests on each bus section.
- (2) Perform dielectric withstand voltage tests.
- (3) Perform insulation-resistance test on control wiring; Do not perform this test on wiring connected to solid-state components.
- (4) Perform control wiring performance test.

- (5) Perform primary current injection tests on the entire current circuit in each section of assembly.
- (6) Perform phasing check on double-ended switchgear to ensure correct bus phasing from each source.
- (7) Verify operation of switchgear heaters.

3.5.1.2 Circuit Breakers - Low Voltage - Power

a. Visual and Mechanical Inspection

- (1) Compare nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Inspect anchorage, alignment, and grounding.
- (4) Verify that all maintenance devices are available for servicing and operating the breaker.
- (5) Inspect arc chutes.
- (6) Inspect moving and stationary contacts for condition, wear, and alignment.
- (7) Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.
- (8) Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism.
- (9) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (10) Verify cell fit and element alignment.
- (11) Verify racking mechanism.
- (12) Confirm correct application of manufacturer's recommended lubricants.

b. Electrical Tests

- (1) Perform contact-resistance tests on each breaker.
- (2) Perform insulation-resistance tests.
- (3) Adjust Breaker(s) for final settings in accordance with Government provided settings.
- (4) Determine long-time minimum pickup current by primary current injection.

- (5) Determine long-time delay by primary current injection.
- (6) Determine short-time pickup and delay by primary current injection.
- (7) Determine ground-fault pickup and delay by primary current injection.
- (8) Determine instantaneous pickup value by primary current injection.
- (9) Activate auxiliary protective devices, such as ground-fault or undervoltage relays, to ensure operation of shunt trip devices; Check the operation of electrically-operated breakers in their cubicle.
- (10) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.
- (11) Verify operation of charging mechanism.

3.5.1.3 Current Transformers

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Verify correct connection.
- (4) Verify that adequate clearances exist between primary and secondary circuit.
- (5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (6) Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
- (2) Perform insulation-resistance tests.
- (3) Perform polarity tests.
- (4) Perform ratio-verification tests.

3.5.1.4 Metering and Instrumentation

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical Tests

(1) Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

(2) Calibrate watthour meters according to manufacturer's published data.

(3) Verify all instrument multipliers.

(4) Electrically confirm that current transformer and voltage transformer secondary circuits are intact.

3.5.1.5 Grounding System

a. Visual and Mechanical Inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

(1) IEEE 81. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

(2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.5.1.6 Cybersecurity Installation Certification

Furnish a certification that control systems are installed in accordance with DoD Instruction 8500.01, DoD Instruction 8510.01, and as required by individual Service Implementation Policy.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Trip circuit

breakers by operation of each protective device. Test each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, provide the Contracting Officer 5 working days advance notice of the dates and times for checks, settings, and tests.

3.6 Special Testing for Seismic-Resisting Equipment

For the Pier's Shore Power Switchgear, Equipment is required to remain operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise. Seismic component qualification documentation for each piece of equipment must contain the information required in UFC 3-301-02, Section 2-17.2.5 Component Qualification Documentation. Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be less than 5 inches by 7 inches with red letters 1-inch in height on a white background stating "Certified Equipment". The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file". The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

3.7 Special Inspection for Seismic-Resisting Systems and Equipment

Perform special inspections for seismic-resisting systems, equipment and components for structures assigned to Risk Category IV per Section 01 45 35 SPECIAL INSPECTIONS.

-- End of Section --

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SECTION 26 24 13

SWITCHBOARDS

05/15, CHG 1: 08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1 ((2014; Errata 2016) Electric Meters -
Code for Electricity Metering

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products

ASTM A153/A153M (2016a) Standard Specification for Zinc
Coating (Hot-Dip) on Iron and Steel
Hardware

ASTM A240/A240M (2020a) Standard Specification for
Chromium and Chromium-Nickel Stainless
Steel Plate, Sheet, and Strip for Pressure
Vessels and for General Applications

ASTM A653/A653M (2020) Standard Specification for Steel
Sheet, Zinc-Coated (Galvanized) or
Zinc-Iron Alloy-Coated (Galvannealed) by
the Hot-Dip Process

ASTM A780/A780M (2020) Standard Practice for Repair of
Damaged and Uncoated Areas of Hot-Dip
Galvanized Coatings

ASTM D149 (2020) Dielectric Breakdown Voltage and
Dielectric Strength of Solid Electrical
Insulating Materials at Commercial Power
Frequencies

ASTM D709 (2017) Standard Specification for
Laminated Thermosetting Materials

ASTM D1535 (2014; R 2018) Standard Practice for
Specifying Color by the Munsell System

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81 (2012) Guide for Measuring Earth
Resistivity, Ground Impedance, and Earth
Surface Potentials of a Ground System

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C37.13	(2015) Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.90.1	(2013) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.12.28	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA PB 2.1	(2013) General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 V or Less
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA PB 2	(2011) Deadfront Distribution Switchboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 489	(2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 891	(2005; Reprint Oct 2012) Switchboards

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE 100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchboard Drawings; G

SD-03 Product Data

Switchboard; G

SD-06 Test Reports

Switchboard Design Tests; G

Switchboard Production Tests; G

Acceptance Checks and Tests; G

SD-07 Certificates

SD-10 Operation and Maintenance Data

Switchboard Operation and Maintenance, Data Package 5; G

SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals; G

Equipment Test Schedule; G

Required Settings; G

Service Entrance Available Fault Current Label; G

1.5 QUALITY ASSURANCE

1.5.1 Product Data

Include manufacturer's information on each submittal for each component, device and accessory provided with the switchboard including:

- a. Circuit breaker type, interrupting rating, and trip devices, including available settings.

- b. Manufacturer's instruction manuals and published time-current curves (in electronic format) of the main secondary breaker and largest secondary feeder device.

1.5.2 Switchboard Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Identify circuit terminals on wiring diagrams and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate on the drawings adequate clearance for operation, maintenance, and replacement of operating equipment devices. Include the nameplate data, size, and capacity on submittal. Also include applicable federal, military, industry, and technical society publication references on submittals. Include the following:

- a. One-line diagram including breakers, fuses, current transformers, and meters.
- b. Outline drawings including front elevation, section views, footprint, and overall dimensions.
- c. Bus configuration including dimensions and ampere ratings of bus bars.
- d. Markings and NEMA nameplate data, including fuse information (manufacturer's name, catalog number, and ratings).
- e. Circuit breaker type, interrupting rating, and trip devices, including available settings.
- f. Wiring diagrams and elementary diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.
- g. Manufacturer's instruction manuals and published time-current curves (in electronic format) of the main secondary breaker and largest secondary feeder device. Use this information (designer of record) to provide breaker settings that ensures protection and coordination are achieved. For Navy installations, provide electronic format curves using SKM's Power Tools for Windows device library electronic format or EasyPower device library format depending on installation modeling software requirements.

1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site are not acceptable.

1.6 MAINTENANCE

1.6.1 Switchboard Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6.2 Assembled Operation and Maintenance Manuals

Assemble and securely bind manuals in durable, hard covered, water resistant binders. Assemble and index the manuals in the following order with a table of contents:

- a. Manufacturer's O&M information required by the paragraph SD-10, OPERATION AND MAINTENANCE DATA.
- b. Catalog data required by the paragraph SD-03, PRODUCT DATA.
- c. Drawings required by the paragraph SD-02, SHOP DRAWINGS.
- d. Prices for spare parts and supply list.
- e. Information on metering.
- f. Design test reports.
- g. Production test reports.

1.7 WARRANTY

Provide equipment items that are supported by service organizations reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be switchboards and related accessories are specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 SWITCHBOARD

NEMA PB 2 and UL 891.

2.2.1 Ratings

Provide equipment with the following ratings:

- a. Voltage rating: 480Y/277 volts AC, three-phase, 4-wire.
- b. Continuous current rating of the main bus: as indicated.
- c. Short-circuit current rating: as indicated.
- d. UL listed and labeled as service entrance equipment.

2.2.2 Construction

Provide the following:

- a. Switchboard: consisting of one or more vertical sections bolted together to form a rigid assembly and rear aligned.
- b. All circuit breakers: front accessible.
- c. Rear aligned switchboards: front accessible load connections.
- d. Where indicated, "space for future" or "space" means to include a vertical bus provided behind a blank front cover. Where indicated, "provision for future" means full hardware provided to mount a breaker suitable for the location.
- e. Completely factory engineered and assembled, including protective devices and equipment indicated with necessary interconnections, instrumentation, and control wiring.

2.2.2.1 Enclosure

Provide the following:

- a. Enclosure: NEMA ICS 6 Type as indicated.
- b. Enclosure: bolted together with removable bolt-on side and hinged rear covers.

- c. Front and rear doors: provided with padlockable vault handles with a three point catch.
- e. Base: includes any part of enclosure that is within 3 inches of concrete pad.
- f. Galvanized steel: ASTM A123/A123M, ASTM A653/A653M G90 coating, and ASTM A153/A153M, as applicable. Galvanize after fabrication where practicable.
- g. Paint color: ASTM D1535 light gray No. 61 or No. 49 over rust inhibitor.
- h. Paint coating system: comply with IEEE C57.12.28 for galvanized steel.

2.2.2.2 Enclosure

Provide the following for the Pier Industrial Unit Substations:

- a. Enclosure: outdoor NEMA ICS 6 Type 3R fabricated entirely of 12 gauge ASTM A240/A240M type 304 or 304L stainless steel.
- b. Enclosure: bolted together with removable bolt-on side and hinged rear covers, and sloping roof downward toward rear.
- c. Front doors: provided with stainless steel padlockable vault handles with a three point catch.
- d. Bases, frames and channels of enclosure: corrosion resistant and fabricated of ASTM A240/A240M type 304 or 304L stainless steel.
- e. Paint color: ASTM D1535 light gray No. 61 or No. 49 over rust inhibitor.
- f. Paint coating system: comply with IEEE C57.12.29 for stainless steel.

2.2.2.3 Bus Bars

Provide the following for the Warehouse switchboard:

- a. Bus bars: copper with silver-plated contact surfaces.
 - (1) Phase bus bars: insulated with a tape wrap or insulating sleeve providing a minimum breakdown voltage of 16,000 volts per ASTM D149.
- b. Make bus connections and joints with hardened steel bolts.
- c. Main-bus (through bus): rated at the full ampacity of the main throughout the switchboard.
- d. Minimum one-quarter by 2 inch copper ground bus secured to each vertical section along the entire length of the switchboard.

2.2.2.4 Main Section

Provide the main section consisting of an individually mounted drawout.

2.2.2.5 Distribution Sections

Provide the distribution section consisting of molded-case circuit breakers as indicated.

2.2.2.6 Handles

Provide handles for individually mounted devices of the same design and method of external operation. Label handles prominently to indicate device ampere rating, color coded for device type. Identify ON-OFF indication by handle position and by prominent marking.

2.2.3 Protective Device

Provide main and branch protective devices as indicated.

2.2.3.1 Power Circuit Breaker

Provide the following:

- a. IEEE C37.13. manually operated drawout, unfused, low-voltage power circuit breaker with a short-circuit current rating as indicated.
- b. Breaker frame size: as indicated.

2.2.3.2 Molded-Case Circuit Breaker

Provide the following:

- a. UL 489. UL listed and labeled, 100 percent rated main breaker, manually operated, low voltage molded-case circuit breaker, with a short-circuit current rating of as indicated at 480 volts.
- b. Breaker frame size: as indicated.
- c. Series rated circuit breakers are unacceptable.

2.2.4 Drawout Breakers

Provide drawout breakers as indicated for switchboard main breakers. Equip drawout breakers with disconnecting contacts, wheels, and interlocks for drawout application. Provide main, auxiliary, and control disconnecting contacts with silver-plated, multifinger, positive pressure, self-aligning type. Provide each drawout breaker with four-position operation with each position clearly identified by an indicator on the circuit breaker front panel as follows.

- a. Connected Position: Primary and secondary contacts are fully engaged. Breaker must be tripped before racking into or out of position.
- b. Test Position: Primary contacts are disconnected but secondary contacts remain fully engaged. This position allows complete test and operation of the breaker without energizing the primary circuit.
- c. Disconnected Position: Primary and secondary contacts are disconnected.
- d. Withdrawn (Removed) Position: Places breaker completely out of

compartment, ready for removal. Removal of the breaker actuates assembly that isolates the primary stabs.

2.2.5 Electronic Trip Units

Equip main and distribution breakers with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that provides true rms sensing adjustable time-current circuit protection. Include the following:

- a. Current sensors ampere rating: the same as the breaker frame rating.
- b. Trip unit ampere rating: as indicated.
- c. Ground fault protection: zero sequence sensing.
- d. Electronic trip units: provide additional features:
 - (1) Main breakers: include short delay pick-up and time settings and, instantaneous settings and ground fault settings.
 - (2) Distribution breakers: include short delay pick-up and time settings, and instantaneous settings.
 - (3) Main Breakers: include provisions for communication via a network twisted pair cable for remote monitoring and control. Provide the following communications protocol: DNP3.
 - (4) For electronic trip units that are rated for or can be adjusted to 1,200 amperes or higher, provide arc energy reduction capability with an energy-reducing maintenance switch with local status indicator.

2.2.6 Metering

2.2.6.1 Digital Meters

IEEE C37.90.1 for surge withstand. Provide true rms, plus/minus one percent accuracy, programmable, microprocessor-based meter enclosed in a sealed case with the following features.

- a. Display capability:
 - (1) Multi-Function Meter: Display a selected phase to neutral voltage, phase to phase voltage, percent phase to neutral voltage THD, percent phase to phase voltage THD; a selected phase current, neutral current, percent phase current THD, percent neutral current; selected total PF, kW, KVA, kVAR, FREQ, kVAh, kWh. Detected alarm conditions include over/under current, over/under voltage, over/under KVA, over/under frequency, over/under selected PF/kVAR, voltage phase reversal, voltage imbalance, reverse power, over percent THD. Include a Form C KYZ pulse output relay on the meter.
- b. Design meters to accept input from standard 5A secondary instrument transformers and direct voltage monitoring range to 600 volts, phase to phase.
- c. Provide programming via a front panel display and a communication

interface accessible by a computer.

- d. Provide password secured programming stored in non-volatile EEPROM memory.
- e. Provide digital communications in a Modbus protocol via a RS232C serial port.
- f. Provide meter that calculates and stores average max/min demand values with time and date for all readings based on a user selectable sliding window averaging period.
- g. Provide meter with programmable hi/low set limits with two Form C dry contact relays when exceeding alarm conditions.
- h. Capable of recording readings at one-hour intervals or less. Meters must record consumption and demand, and must store data for a minimum of 36 months. Meters must be capable of reporting hourly, daily, monthly and annual.

2.2.6.2 Electronic Watthour Meter

Provide as specified in Section 26 27 14.00 20 ELECTRICITY METERING.

2.2.7 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Provide short-circuiting type terminal boards associated with current transformer. Terminate conductors for current transformers with ring-tongue lugs. Provide terminal board identification that is identical in similar units. Provide color coded external wiring that is color coded consistently for similar terminal boards.

2.2.8 Wire Marking

Mark control and metering conductors at each end. Provide factory installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Provide a single letter or number on each sleeve, elliptically shaped to securely grip the wire, and keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Indicate on each wire marker the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.3 MANUFACTURER'S NAMEPLATE

Provide a nameplate on each item of equipment bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not acceptable. This nameplate and method of attachment may be the manufacturer's standard if it contains the required information.

2.4 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each switchboard, equipment enclosure, relay, switch, and device; as specified in this

section or as indicated on the drawings. Identify on each nameplate inscription the function and, when applicable, the position. Provide nameplates of melamine plastic, 0.125 inch thick, white with black center core. Provide matte finish surface. Provide square corners. Accurately align lettering and engrave into the core. Provide nameplates with minimum size of one by 2.5 inches. Provide lettering that is a minimum of 0.25 inch high normal block style.

2.5 SOURCE QUALITY CONTROL

2.5.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

Provide the following as part of test equipment calibration:

- a. Provide a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
- b. Accuracy: Traceable to the National Institute of Standards and Technology.
- c. Instrument calibration frequency schedule: less than or equal to 12 months for both test floor instruments and leased specialty equipment.
- d. Dated calibration labels: visible on all test equipment.
- e. Calibrating standard: higher accuracy than that of the instrument tested.
- f. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:
 - (1) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
 - (2) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.5.2 Switchboard Design Tests

NEMA PB 2 and UL 891.

2.5.2.1 Design Tests

Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

- a. Short-circuit current test.
- b. Enclosure tests.

- c. Dielectric test.

2.5.3 Switchboard Production Tests

NEMA PB 2 and UL 891. Furnish reports which include results of production tests performed on the actual equipment for this project. These tests include:

- a. 60-hertz dielectric tests.
- b. Mechanical operation tests.
- c. Electrical operation and control wiring tests.
- d. Ground fault sensing equipment test.

2.6 ARC FLASH WARNING LABEL

Provide warning label for switchboards. Locate this self-adhesive warning label on the outside of the enclosure warning of potential electrical arc flash hazards and appropriate PPE required. Provide label format as indicated.

2.7 SERVICE ENTRANCE AVAILABLE FAULT CURRENT LABEL

Provide label on exterior of switchboards used as service equipment listing the maximum available fault current at that location. Include on the label the date that the fault calculation was performed and the contact information for the organization that completed the calculation. Locate this self-adhesive warning label on the outside of the switchboard. Provide label format as indicated.

2.8 MIMIC BUS LABELING

Provide a mimic bus on the front of the equipment to diagrammatically show the internal bus structure of the lineup.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounds and grounding systems with a resistance to solid earth ground not exceeding 25 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of the ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Equipment Grounding

Provide bare copper cable not smaller than No. 4/0 AWG not less than 24 inches below grade connecting to the indicated ground rods. When work in addition to that indicated or specified is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" applies.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect equipment furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Switchboard

ANSI/NEMA PB 2.1.

3.3.2 Meters and Instrument Transformers

ANSI C12.1.

3.3.3 Field Applied Painting

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.3.4 Galvanizing Repair

Repair damage to galvanized coatings using ASTM A780/A780M, zinc rich paint, for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces that repair paint has been applied to.

3.3.5 Field Fabricated Nameplate Mounting

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.4.1 Interior Location

Mount switchboard on concrete slab as follows:

- a. Unless otherwise indicated, provide the slab with dimensions at least

4 inches thick.

- b. Install slab such that the top of the concrete slab is approximately 4 inches above the finished grade.
- c. Provide edges above grade 1/2 inch chamfer.
- d. Provide slab of adequate size to project at least 8 inches beyond the equipment.
- e. Provide conduit turnups and cable entrance space required by the equipment to be mounted.
- f. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant.
- g. Cut off and bush conduits 3 inches above slab surface.
- h. Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.5 FIELD QUALITY CONTROL

Submit Required Settings of breakers to the Contracting Officer after approval of switchboard and at least 30 days in advance of their requirement.

3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Switchboard Assemblies

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical, electrical, and mechanical condition.
- (3) Verify appropriate anchorage, required area clearances, and correct alignment.
- (4) Clean switchboard and verify shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.
- (5) Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.
- (6) Verify that circuit breaker sizes and types correspond to approved shop drawings as well as to the circuit breaker's address for microprocessor-communication packages.
- (7) Verify that current transformer ratios correspond to approved shop drawings.
- (8) Inspect all bolted electrical connections for high resistance

using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

- (9) Confirm correct operation and sequencing of electrical and mechanical interlock systems.
- (10) Confirm correct application of manufacturer's recommended lubricants.
- (11) Inspect insulators for evidence of physical damage or contaminated surfaces.
- (12) Verify correct barrier installation and operation.
- (13) Exercise all active components.
- (14) Inspect all mechanical indicating devices for correct operation.
- (15) Verify that filters are in place and vents are clear.
- (16) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.
- (17) Inspect control power transformers.

b. Electrical Tests

- (1) Perform insulation-resistance tests on each bus section.
- (2) Perform dielectric withstand voltage tests.
- (3) Perform insulation-resistance test on control wiring; Do not perform this test on wiring connected to solid-state components.
- (4) Perform control wiring performance test.
- (5) Perform primary current injection tests on the entire current circuit in each section of assembly.

3.5.1.2 Circuit Breakers - Low Voltage - Power

a. Visual and Mechanical Inspection

- (1) Compare nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Inspect anchorage, alignment, and grounding.
- (4) Verify that all maintenance devices are available for servicing and operating the breaker.
- (5) Inspect arc chutes.
- (6) Inspect moving and stationary contacts for condition, wear, and alignment.

- (7) Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.
- (8) Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism.
- (9) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (10) Verify cell fit and element alignment.
- (11) Verify racking mechanism.
- (12) Confirm correct application of manufacturer's recommended lubricants.

b. Electrical Tests

- (1) Perform contact-resistance tests on each breaker.
- (2) Perform insulation-resistance tests.
- (3) Adjust Breaker(s) for final settings in accordance with Government provided settings.
- (4) Determine long-time minimum pickup current by primary current injection.
- (5) Determine long-time delay by primary current injection.
- (6) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.
- (7) Verify operation of charging mechanism.

3.5.1.3 Circuit Breakers

Low Voltage Molded Case with Solid State Trips

a. Visual and Mechanical Inspection

- (1) Compare nameplate data with specifications and approved shop drawings.
- (2) Inspect circuit breaker for correct mounting.
- (3) Operate circuit breaker to ensure smooth operation.
- (4) Inspect case for cracks or other defects.
- (5) Inspect all bolted electrical connections for high resistance using low resistance ohmmeter, verifying tightness of accessible bolted connections and/or cable connections by calibrated torque-wrench method, or performing thermographic survey.

- (6) Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

- (1) Perform contact-resistance tests.
- (2) Perform insulation-resistance tests.
- (3) Perform Breaker adjustments for final settings in accordance with Government provided settings.
- (4) Perform long-time delay time-current characteristic tests
- (5) Determine short-time pickup and delay by primary current injection.
- (6) Determine ground-fault pickup and time delay by primary current injection.
- (7) Determine instantaneous pickup current by primary injection.

3.5.1.4 Current Transformers

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Verify correct connection.
- (4) Verify that adequate clearances exist between primary and secondary circuit.
- (5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (6) Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
- (2) Perform insulation-resistance tests.
- (3) Perform polarity tests.
- (4) Perform ratio-verification tests.

3.5.1.5 Metering and Instrumentation

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical Tests

(1) Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

(2) Calibrate watthour meters according to manufacturer's published data.

(3) Verify all instrument multipliers.

(4) Electrically confirm that current transformer and voltage transformer secondary circuits are intact.

3.5.1.6 Grounding System

a. Visual and Mechanical Inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

(1) IEEE 81. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

(2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Trip circuit breakers by operation of each protective device. Test each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, provide the Contracting Officer 5 working days advance notice of the dates and times for checks, settings, and tests.

3.6 Special Testing for Seismic-Resisting Equipment

The Pier Industrial Unit Substations and components are required to remain

operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise. Seismic component qualification documentation for each piece of equipment must contain the information required in UFC 3-301-02, Section 2-17.2.5 Component Qualification Documentation. Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be less than 5 inches by 7 inches with red letters 1-inch in height on a white background stating "Certified Equipment". The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file". The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

3.7 Special Inspection for Seismic-Resisting Systems and Equipment

For the Pier Industrial Unit Substations perform special inspections for seismic-resisting systems, equipment and components for structures assigned to Risk Category IV per Section 01 45 35 SPECIAL INSPECTIONS.

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SECTION 26 27 14.00 20

ELECTRICITY METERING

02/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1 ((2014; Errata 2016) Electric Meters -
Code for Electricity Metering

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP (2013) Energy Standard for Buildings
Except Low-Rise Residential Buildings

ASHRAE 90.1 - SI (2013) Energy Standard for Buildings
Except Low-Rise Residential Buildings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.90.1 (2013) Standard for Surge Withstand
Capability (SWC) Tests for Relays and
Relay Systems Associated with Electric
Power Apparatus

IEEE C57.13 (2016) Requirements for Instrument
Transformers

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2017; Errata 2017) Standard for
Acceptance Testing Specifications for
Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.7 (2014) Requirements for Watthour Meter
Sockets

ANSI C12.18 (2006; R 2016) Protocol Specification for
ANSI Type 2 Optical Port

ANSI C12.20 (2015; E 2018) Electricity Meters - 0.1,
0.2, and 0.5 Accuracy Classes

NEMA C12.19 (2012) Utility Industry End Device Data
Tables

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Electricity Meters; G

Current Transformer; G

Potential Transformer; G

External Communications Devices; G

Configuration Software; G

The most recent version of the configuration software for each type (manufacturer and model) must be submitted as a Technical Data Package and must be licensed to the project site. Software must be submitted on CD-ROM and two hard copies of the software user manual must be submitted for each piece of software provided.

SD-06 Test Reports

Acceptance Checks and Tests; G

System Functional Verification; G

Building Meter Installation Sheet, per Building; G

Completed Meter Installation Schedule; G

Completed Meter Data Schedule; G

Meter Configuration Template; G

Contractor must fill in the meter configuration template and submit to the Activity for concurrence.

Meter Configuration Report; G

The meter configuration report must be submitted as a Technical Data Package.

SD-10 Operation and Maintenance Data

Electricity Meters and Accessories, Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23
OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

System Functional Verification; G

1.3 QUALITY ASSURANCE

1.3.1 Installation Drawings

Drawings must be provided in hard-copy and PDF electronic format, and must include but not be limited to the following:

- a. Wiring diagrams with terminals identified of kilowatt advanced meter, current transformers, protocol modules, and communications interfaces. For each typical meter installation, provide a diagram.
- b. One-line diagram, including meters, switch(es), current transformers, protocol modules, communications interfaces, and fuses. For each typical meter installation, provide a diagram. Provide one-line diagram to the local Public Works department.

1.3.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for one year prior to bid opening. The one-year period must include applications of equipment and materials under similar circumstances and of similar size. The product, or an earlier release of the product, must have been on sale on the commercial market through advertisements, manufacturers catalogs, or brochures during the prior one-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.3.3 Material and Equipment Manufacturing Data

Products manufactured more than 1 year prior to date of delivery to site must not be used, unless specified otherwise.

1.4 MAINTENANCE

1.4.1 Additions to Operation and Maintenance Data

In addition to requirements of Data Package 5, include the following on the actual electricity meters and accessories provided:

- a. A condensed description of how the system operates
- b. Block diagram indicating major assemblies
- c. Troubleshooting information
- d. Preventive maintenance

- e. Prices for spare parts and supply list

1.5 WARRANTY

The equipment items and software must be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment and software on a regular and emergency basis during the warranty period of the contract.

1.6 SYSTEM DESCRIPTION

1.6.1 System Requirements

Electricity metering, consisting of meters and associated equipment, will be used to record the electricity consumption and other values as described in the requirements that follow and as shown on the drawings. Communication system requirements are contained in a separate specification section as identified in paragraph COMMUNICATIONS INTERFACES.

1.6.2 Selection Criteria

Metering components and software are part of a system that includes the physical meter, data recorder function and communications method. Every building site identified must include sufficient metering components to measure the electrical parameters identified and to store and communicate the values as required.

Contractor must verify that the electricity meter installed on any building site is compatible with the base-wide metering system with respect to the types of meters selected and the method used to program the meters for initial use. Software and meter programming tools are necessary to set up the meters described by this specification. New software tools different from the meter programming methods currently used by base personnel will require an Authority to Operate (ATO) by Command Information Office at the Enterprise level.

PART 2 PRODUCTS

2.1 ELECTRICITY METERS AND ACCESSORIES

Provide meter(s) and connect the meter(s) to the existing AMI DAS. The contractor must use the existing government laptop computers to configure the meter using existing software loaded on the computer. The contractor will not be allowed to modify any software or add any additional software to the computer. Contractor must insure that the meter(s) will transmit the specified data to the DAS.

2.1.1 Physical and Common Requirements

- a. Provide metering system components in accordance with the Metering System Schedule shown in this specification. Provide Meter configuration template.
- b. Meter must have NEMA 3R stainless steel enclosure for surface mounting with bottom or rear penetrations.
- c. Surge withstand capability must conform to IEEE C37.90.1.

- d. Use #12 SIS (XHHW, or equivalent) wiring with ring lugs for all meter connections. Color code and mark the conductors as follows:

- (1) Red - Phase A CT - C1
- (2) Orange - Phase B CT - C2
- (3) Brown - Phase C CT - C3
- (4) Gray with white stripe - neutral current return - C0
- (5) Black - Phase A voltage - V1
- (6) Yellow - Phase B voltage - V2
- (7) Blue - Phase C voltage - V3
- (8) White - Neutral voltage

2.1.2 Potential Transformer Requirements

- a. Meter must be capable of connection to the service voltage phases and magnitude being monitored. If the meter is not rated for the service voltage, provide suitable potential transformers to send an acceptable voltage to the meter.
- b. Voltage input must be optically isolated to 2500 volts DC from signal and communications outputs. Components must meet or exceed IEEE C37.90.1.
- c. Provide a pull-out type fuse block containing one fuse per phase, Class RK type, to protect the voltage input to the meter. Size fuses as recommended by the meter manufacturer. Fusing must either be inside the secondary compartment of the transformer or inside the same enclosure as the CT shorting device.

2.1.3 Current Transformer Requirements

- a. Current transformer must be installed with a rating as shown in the schedule.
- b. Current transformers must have an Accuracy Class of 0.3 (with a maximum error of plus/minus 0.3 percent at 5.0 amperes) when operating within the specified rating factor.
- c. Current transformers must be solid-core, bracket-mounted for new installations using ring-tongue lugs for electrical connections. Current transformers must be accessible and the associated wiring must be installed in an organized and neat workmanship arrangement. Current transformers that are retrofitted onto existing switchgear busbar can be a busbar split-core design.
- d. Current transformers must have:
 - (1) Insulation Class: All 600 volt and below current transformers must be rated 10 KV BIL.
 - (2) Frequency: Nominal 60 Hz.
 - (3) Burden: Burden class must be selected for the load.
 - (4) Phase Angle Range: 0 to 60 degrees.
- e. Meter must accept current input from standard instrument transformers

(5A secondary current transformers).

- f. Current inputs must have a continuous rating in accordance with IEEE C57.13.
- g. Provide one single-ratio current transformer for each phase per power transformer with characteristics listed in the following table.

Single-Ratio Current Transformer Characteristics				
kVA	Sec. Volt	CT Ratio	RF	Meter Acc. Class
750	480Y:277	800/5	1.33	0.3 thru B0.05

2.1.4 Meter Requirements

Notwithstanding any other provision of this contract, meters must be ; no other product will be acceptable. All meters must meet NAVFAC Cyber Security Requirements.

Electricity meters must include the following features:

- a. Meter must comply with ANSI C12.1, NEMA C12.19, and ANSI C12.20 and must match existing AMI meter system at the installation and be the newest version with ATO.
- b. Meter sockets must comply with ANSI C12.7.
- c. Provide socket-mounted or panel mounted meters as indicated on the meter schedule.
 - (1) Panel-mounted meters must be semi-flush, back-connected, dustproof, draw-out switchboard type. Cases must have window removable covers capable of being sealed against tampering. Meters must be of a type that can be withdrawn through approved sliding contacts from fronts of panels or doors without opening current-transformer secondary circuits, disturbing external circuits, or requiring disconnection of any meter leads. Necessary test devices must be incorporated within each meter and must provide means for testing either from an external source of electric power or from associated instrument transformers or bus voltage.
- d. Meter must be a Class 20, transformer rated design.
- e. Use Class 200 meters for direct current reading without current transformers for applications with an expected load less than 200 amperes, where indicated.
- f. Meter must be rated for use at temperature from minus 40 degrees Centigrade to plus 70 degrees Centigrade.
- g. The meters must have an electronic demand recording register and must be secondary reading as indicated. The register must be used to indicate maximum kilowatt demand as well as cumulative or continuously

cumulative demand. Demand must be measured on a block-interval basis and must be capable of a 5 to 60 minute interval and initially set to a 15-minute interval. It must have provisions to be programmed to calculate demand on a rolling interval basis. Meter readings must be true RMS.

- h. The meter electronic register must be of modular design with non-volatile data storage. Downloading meter stored data must be capable via an port. Recording capability of data storage with a minimum capability of 89 days of 15 minute, 2 channel interval data. The meter must be capable of providing at least 2 KYZ pulse outputs (dry contacts). Default initial configuration (unless identified otherwise by base personnel) must meet NAVFAC CIRCUITS Call for Consistency document located on the NAVFAC CIRCUITS Portal and must be:
 - (1) First channel - kWh
 - (2) Second channel - kVARh
 - (3) KYZ output #1 - kWh
 - (4) KYZ output #2 - kVARh
- i. All meters must have identical features available in accordance with this specification. The meter schedule identifies which features must be activated at each meter location.
- j. Enable switches for Time of Use (TOU), pulse and load profile measurement module at the factory.
- k. Meter must have an optical port on front of meter. Optical device must be compatible with ANSI C12.18.
- l. Meters must be 120-480 volts auto ranging.
- m. Provide blank tag fixed to the meter faceplate for the addition of the meter multiplier, which will be the product of the current transformer and potential transformer ratio and will be filled in by base personnel on the job site. The meter's nameplate must include:
 - (1) Meter ID number.
 - (2) Rated voltage.
 - (3) Current class.
 - (4) Metering form.
 - (5) Test amperes.
 - (6) Frequency.
 - (7) Catalog number.
 - (8) Manufacturing date.
- n. On switchboard style installations, provide switchboard case with disconnect means for meter removal incorporating short-circuiting of current transformer circuits.
- o. Meter covers must be polycarbonate resins with an optical port and reset. Backup battery must be easily accessible for change-out after removing the meter cover.
- p. The normal billing data scroll must be fully programmable. The normal billing data scroll requirements provided in the CIRCUITS Call for Consistency Document located on the NAVFAC CIRCUITS Portal. Data scroll display must include the following.

- (1) Number of demand resets.
 - (2) End-of-interval indication.
 - (3) Maximum demand.
 - (4) New maximum demand indication.
 - (5) Cumulative or continuously cumulative.
 - (6) Time remaining in interval.
 - (7) Kilowatt hours.
- q. The register must incorporate a built-in test mode that allows it to be tested without the loss of any data or parameters. The following quantities must be available for display in the test mode:
 - (1) Present interval's accumulating demand.
 - (2) Maximum demand.
 - (3) Number of impulses being received by the register.
- r. Pulse module simple I/O board with programmable ratio selection.
- s. Meters must be programmed after installation via an port. Optical display must show TOU data, peak kWh, semi-peak kWh, off peak kWh, and phase angles.
- t. Self-monitoring to provide for:
 - (1) Unprogrammed register.
 - (2) RAM checksum error.
 - (3) ROM checksum error.
 - (4) Hardware failure.
 - (5) Memory failure.
 - (6) EPROM error.
 - (7) Battery status (fault, condition, or time in service).
- u. Liquid crystal alphanumeric displays, 9 digits, blinking squares confirm register operation. Six Large digits for data and smaller digits for display identifier.
- v. Display operations, programmable sequence with display identifiers. Display identifiers must be selectable for each item. Continually sequence with time selectable for each item.
- w. The meters must support three modes of registers: Normal Mode, Alternate Mode, and Test Mode. The meter also must support a "Toolbox" or "Service Information" (accessible in the field) through an optocom port to a separate computer using the supplied software to allow access to instantaneous service information such as voltage, current, power factor, load demand, and the phase angle for individual phases.
- x. Meter must have a standard 4 -year warranty.

2.1.5 Disconnect Method

- a. Provide a 10-pole safety disconnect complete with isolation devices for the voltage and current transformer inputs, including a shorting means for the current transformers.

2.1.6 Installation Methods

- a. Transformer Mounted ("XFMR" in Metering Systems Schedule). Meter base

must be located outside on the secondary side of the pad-mounted transformer.

- d. Panel Mounted. ("PNL" in Metering Systems Schedule). Meter must be mounted where directed.

2.2 COMMUNICATIONS INTERFACES

Meter must have two-way communication with the existing data acquisition system (DAS). Provide a communications interface utilizing IEEE 802.3.

Provide interfacing software if a meter is used that is different than the existing meters at the Activity to ensure compatibility within the metering system.

Connect to the AMI network utilizing IEEE 802.3.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations must conform to ASHRAE 90.1 - IP, ASHRAE 90.1 - SI IEEE C2, NFPA 70 (National Electrical Code), and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.1.1 Scheduling of Work and Outages

The Contract Clauses must govern regarding permission for power outages, scheduling of work, coordination with Government personnel, and special working conditions.

3.1.2 Configuration Software

The standard meter must include the latest available version of firmware and software. Meter must either be programmed at the factory or must be programmed in the field. Meters must have a password that must be provided to the contracting officer upon project completion. When field programming is performed, turn field programming device over to the Contracting Officer at completion of project. When interfacing software is used for a meter that is different than the existing meters in use at the Activity, turn the software over to the Contracting Officer at completion of the project.

3.2 FIELD QUALITY CONTROL

Perform the following acceptance checks and tests on all installed meters.

3.2.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

- a. Meter Assembly

- (1) Visual and mechanical inspection.

- (a) Compare equipment nameplate data with specifications and

approved shop drawings.

(b) Inspect physical and mechanical condition. Confirm the meter is firmly seated in the socket, the socket is not abnormally heated, the display is visible, and the ring and seal on the cover are intact.

(c) Inspect all electrical connections to ensure they are tight. For Class 200 services, verify tightness of the service conductor terminations for high resistance using low-resistance ohmmeter, or by verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.

(d) Record model number, serial number, firmware revision, software revision, and rated control voltage.

(e) Verify operation of display and indicating devices.

(f) Record password and user log-in for each meter.

(g) Verify grounding of metering enclosure.

(h) Set all required parameters including instrument transformer ratios, system type, frequency, power demand methods/intervals, and communications requirements. Verify that the CT ratio and the PT ratio are properly included in the meter multiplier or the programming of the meter. Confirm that the multiplier is provided on the meter face or on the meter.

(i) Provide building meter installation sheet, per building for each facility. See example Graphic E-S1.

(j) Provide the completed meter installation schedule for the installation if multiple meters are to be used. See example Graphic E-S2

(k) Provide the completed meter data schedule for the installation if multiple meters are to be used. See example Graphic E-S3.

(2) Electrical tests.

(a) Apply voltage or current as appropriate to each analog input and verify correct measurement and indication.

(b) Confirm correct operation and setting of each auxiliary input/output feature including mechanical relay, digital, and analog.

(c) After initial system energization, confirm measurements and indications are consistent with loads present.

(d) Make note of, and report, any "Error-Code" or "Caution-Code" on the meter's display.

(3) Provide meter configuration report.

b. Current Transformers

(1) Visual and mechanical inspection.

- (a) Compare equipment nameplate data with specification and approved shop drawings.
- (b) Inspect physical and mechanical condition.
- (c) Verify correct connection, including polarity.
- (d) Inspect all electrical connections to ensure they are tight.
- (e) Verify that required grounding and shorting connections provide good contact.

(2) Electrical Tests.

Verify proper operation by reviewing the meter configuration report.

c. Potential Transformers

(1) Visual and mechanical inspection.

- (a) Verify potential transformers are rigidly mounted.
- (b) Verify potential transformers are the correct voltage.
- (c) Verify that adequate clearances exist between the primary and secondary circuit.

(2) Electrical Tests.

- (a) Verify by the meter configuration report that the polarity and phasing are correct.

3.2.2 System Functional Verification

Verify that the installed meters are working correctly in accordance with the meter configuration report:

- a. The correct meter form is installed.
- b. All voltage phases are present.
- c. Phase rotation is correct.
- d. Phase angles are correct.
- e. The new meter accurately measures power magnitude and direction, and can communicate as required by paragraph COMMUNICATIONS INTERFACES.

-- End of Section --

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SECTION 26 29 23

ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS
02/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

EUROPEAN COMMITTEE FOR STANDARDIZATION (CEN/CENELEC)

EN 61800-3 (2017) Requirements for the Control of
Electromagnetic Interference
Characteristics of Subsystems and Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519 (2014) Recommended Practices and
Requirements for Harmonic Control in
Electrical Power Systems

IEEE C62.41.1 (2002; R 2008) Guide on the Surges
Environment in Low-Voltage (1000 V and
Less) AC Power Circuits

IEEE C62.41.2 (2002) Recommended Practice on
Characterization of Surges in Low-Voltage
(1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2018) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NEMA ICS 1 (2000; R 2015) Standard for Industrial
Control and Systems: General Requirements

NEMA ICS 3.1 (2019) Guide for the Application,
Handling, Storage, Installation and
Maintenance of Medium-Voltage AC
Contactors, Controllers and Control Centers

NEMA ICS 6 (1993; R 2016) Industrial Control and
Systems: Enclosures

NEMA ICS 7 (2014) Adjustable-Speed Drives

NEMA ICS 7.2 (2015) Application Guide for AC Adjustable
Speed Drive Systems

NEMA MG 1 (2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15 Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 489 (2016; Rev 2019) UL Standard for Safety
Molded-Case Circuit Breakers, Molded-Case
Switches and Circuit-Breaker Enclosures

UL 508C (2002; Reprint Nov 2010) Power Conversion
Equipment

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM applies to this section with additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Performance Requirements

1.3.1.1 Electromagnetic Interference Suppression

Computing devices, as defined by 47 CFR 15 and EN 61800-3 rules and regulations, must be certified to comply with the requirements for class A computing devices and labeled.

1.3.1.2 Electromechanical and Electrical Components

Ensure electrical and electromechanical components of the Adjustable Speed Drive (ASD) do not cause electromagnetic interference to adjacent electrical or electromechanical equipment while in operation.

1.3.2 Electrical Requirements

1.3.2.1 Power Line Surge Protection

IEEE C62.41.1 and IEEE C62.41.2, IEEE 519 Control panel must have surge protection, included within the panel to protect the unit from damaging transient voltage surges. Surge protective device must be mounted near the incoming power source and properly wired to all three phases and ground. Fuses must not be used for surge protection.

1.3.2.2 Sensor and Control Wiring Surge Protection

I/O functions as specified must be protected against surges induced on control and sensor wiring installed outdoors and as shown. Test the inputs and outputs in both normal mode and common mode using the following two waveforms:

- a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

- b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

- Schematic Diagrams; G
- Interconnecting Diagrams; G
- Installation Drawings; G
- As-Built Drawings; G

SD-03 Product Data

- Adjustable Speed Drives; G
- Wires and Cables
- Equipment Schedule

SD-06 Test Reports

- ASD Test
- Performance Verification Tests
- Endurance Test

SD-07 Certificates

- Testing Agency's Field Supervisor NETA Certificate; G

SD-08 Manufacturer's Instructions

- Installation instructions

SD-09 Manufacturer's Field Reports

- ASD Test Plan; G
- Standard Products

SD-10 Operation and Maintenance Data

- Adjustable Speed Drives, Data Package 4

1.5 QUALITY ASSURANCE

1.5.1 Schematic Diagrams

Submit diagrams showing circuits and device elements for each replaceable module. Schematic diagrams of printed circuit boards are permitted to group functional assemblies as devices, provided that sufficient information is provided for government maintenance personnel to verify proper operation of the functional assemblies.

1.5.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.5.3 Installation Drawings

Show floor plan of each site, with ASD's and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes. Submit drawings for government approval prior to equipment construction or integration. Immediately record modifications to original drawings made during installation for inclusion into the as-built drawings.

1.5.4 Equipment Schedule

Provide schedule of equipment supplied. Schedule must provide a cross reference between manufacturer data and identifiers indicated in shop drawings. Schedule must include the total quantity of each item of equipment supplied and data indicating compatibility with motors being driven. For complete assemblies, such as ASD's, provide the serial numbers of each assembly, and a sub-schedule of components within the assembly. Provide recommended spare parts listing for each assembly or component.

1.5.5 Installation Instructions

Provide installation instructions issued by the manufacturer of the equipment, including notes and recommendations, prior to shipment to the site. Provide operation instructions prior to acceptance testing.

1.5.6 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6 DELIVERY AND STORAGE

Store delivered equipment to protect from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 WARRANTY

The complete system must be warranted by the manufacturer for a period of one year. Repair or replace any component failing to perform its function as specified and documented at no additional cost to the Government. Items repaired or replaced must be warranted for an additional period of at least one year from the date that it becomes functional again, as specified in FAR 52.246-21 Warranty of Construction.

1.8 MAINTENANCE

1.8.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

1.8.2 Operation and Maintenance Data

Provide in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Provide additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit. Include copies of as-built submittals. Provide routine preventative maintenance instructions, and equipment required. Provide instructions on how to modify program settings, and modify the control program. Provide instructions on drive adjustment, trouble-shooting, and configuration. Provide instructions on process tuning and system calibration.

1.8.3 Maintenance Support

During the warranty period, provide on-site, on-call maintenance services by drive manufacturer's personnel on the following basis: The service must be on a per-call basis with 36 hour response. Contractor is responsible for the maintenance of all hardware and software of the system during the warranty period. Various personnel of different expertise must be sent on-site depending on the nature of the maintenance service required. Costs must include travel, local transportation, living expenses, and labor rates of the service personnel while responding to the service request. The provisions of this Section are not in lieu of, nor relieve the Contractor of, warranty responsibilities covered in this specification. Should the result of the service request be the uncovering of a system defect covered under the warranty provisions, all costs for the call, including the labor necessary to identify the defect, must be borne by the Contractor.

1.8.4 Technical Support

Provide the ASDs with manufacturer's technical telephone support in English, readily available during normal working hours.

PART 2 PRODUCTS

2.1 ADJUSTABLE SPEED DRIVES (ASD)

Provide adjustable speed drive to control the speed of induction motor(s). The ASD must include the following minimum functions, features and ratings.

- a. Provide every VFD with integral disconnect switch.
- b. Input circuit breaker per UL 489 with a minimum of 10,000 amps symmetrical interrupting capacity and door interlocked external operator.
- c. A converter stage per UL 508C must change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter must utilize a full wave bridge design incorporating diode rectifiers. Silicon Controlled Rectifiers (SCR) are not acceptable. The converter must be insensitive to three phase rotation of the ac line and must not cause displacement power factor of less than .95 lagging under any speed and load condition.
- d. An inverter stage must change fixed dc voltage to variable frequency, variable ac voltage for application to a standard NEMA MG 1 Part 30 motor designed for use with adjustable frequency power supplies. Switch the inverter to produce a sine coded pulse width modulated (PWM) output waveform.
- e. The ASD shall be capable of supplying 120 percent of rated full load current for one minute at maximum ambient temperature.
- f. The ASD must be designed to operate from a 480 volt, plus or minus 10 percent, three phase, 60 Hz supply, and control motors with a corresponding voltage rating.
- g. Acceleration and deceleration time must be independently adjustable from one second to 60 seconds.

Required deceleration time may be achieved using not only dynamic braking resistor but with other methods described in NEMA ICS 7.2-2015 paragraph 5.2.5.

- h. Adjustable full-time current limiting must limit the current to a preset value which must not exceed 110 percent of the controller rated current. The current limiting action must maintain the V/Hz ratio constant so that variable torque can be maintained. Short time starting override must allow starting current to reach 175 percent of controller rated current to maximum starting torque.
- i. The controllers must be capable of producing an output frequency over the range of 3 Hz to 60 Hz (20 to one speed range), without low speed cogging. Over frequency protection must be included such that a failure in the controller electronic circuitry must not cause frequency to exceed 110 percent of the maximum controller output frequency selected.
- j. Minimum and maximum output frequency must be adjustable over the following ranges: 1) Minimum frequency 3 Hz to 50 percent of maximum selected frequency; 2) Maximum frequency 40 Hz to 60 Hz.

- k. The controller efficiency at any speed must not be less than 96 percent.
- l. The controllers must be capable of being restarted into a motor coasting in the forward direction without tripping.
- m. Protection of power semiconductor components must be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controllers to any of the following conditions must not result in component failure or the need for fuse replacement:
 - (1) Short circuit at controller output
 - (2) Ground fault at controller output
 - (3) Open circuit at controller output
 - (4) Input undervoltage
 - (5) Input overvoltage
 - (6) Loss of input phase
 - (7) AC line switching transients
 - (8) Instantaneous overload
 - (9) Sustained overload exceeding 115 percent of controller rated current
 - (10) Over temperature
 - (11) Phase reversal
- n. Solid state motor overload protection must be included such that current exceeding an adjustable threshold must activate a 60 second timing circuit. Should current remain above the threshold continuously for the timing period, the controller will automatically shut down.
- o. Include slip compensation circuit that will sense changing motor load conditions and adjust output frequency to provide speed regulation of NEMA MG 1 Part 30 designed for use with adjustable frequency power supplies motors to within plus or minus 0.5 percent of maximum speed without the necessity of a tachometer generator.
- p. The ASD must be factory set for manual restart after the first protective circuit trip for malfunction (overcurrent, undervoltage, overvoltage or overtemperature) or an interruption of power. The ASD must be capable of being set for automatic restart after a selected time delay. If the drive faults again within a specified time period (adjustable 0-60 seconds), a manual restart will be required.
- q. The ASD must include external fault reset capability. All the necessary logic to accept an external fault reset contact must be included.
- r. Provide critical speed lockout circuitry to prevent operating at

frequencies with critical harmonics that cause resonant vibrations.
The ASD must have a minimum of three user selectable bandwidths.

- s. Provide properly sized NEMA rated by-pass and isolation contactors to enable operation of motor in the event of ASD failure. Install mechanical and electrical interlocks between the by-pass and isolation contactors. Provide a selector switch and transfer delay timer. Motor overload and short circuit protective features must remain in use during the bypass mode.
- t. Each individual ASD must meet the following Total Harmonic Distortion (THD) requirements at the input terminals to the factory assembly of the ASD or at the load disconnecting means serving the ASD and filter assembly. These measurements should be taken with the drive set at 90 percent frequency (rpms) and the motor under a minimum of 50 percent demand.

- (1) The Voltage THD should not exceed 2.0 percent THD.

- (2) The Current THD should not exceed 15.0 percent THD.

- (3) If the standard factory ASD does not meet or exceed these requirements the factory must install appropriate equipment (Harmonic Traps, Filters, different Drive technology, etc.) to mitigate the distortion to assure performance of the VFD is within the limits.

- (4) These tests should be performed at the Manufacturers Laboratory facilities and submitted as part of the Product Data Submittals, in order to prevent the necessity of adding mitigation equipment in the field. If the requirements listed above are met, IEEE 519 will also be met.

2.1.1 ASD for Industrial Application

Provide the following operator control and monitoring devices mounted on the front panel of the ASD:

- a. Manual speed potentiometer.
- b. Hand-Off-Auto (HOA) switch.
- c. Power on light.
- d. Drive run power light.
- e. Local display capable of including ASD status, frequency, motor RPM, phase current, fault diagnostic in descriptive text, and all programmed parameters.

2.1.2 ASD for HVAC Application

ASDs must have the following features:

- a. A local operator control providing the following functions:
 - (1) Remote/Local operator selection with password access.
 - (2) Run/Stop and manual speed commands.

- (3) All programming functions.
- (4) Scrolling through all display functions.
- b. A local operator control panel with the following data displayed:
 - (1) ASD status.
 - (2) Frequency.
 - (3) Motor RPM.
 - (4) Phase current.
 - (5) Scrolling through all display functions.
 - (6) Fault diagnostics in descriptive text.
 - (7) All programmed parameters.
- c. Standard PI loop controller with input terminal for controlled variable and parameter settings.
- d. User interface terminals for remote control of ASD speed, speed feedback, and an isolated form C SPDT relay, which energizes on a drive fault condition.
- e. An isolated form C SPDT auxiliary relay which energizes on a run command.
- f. An adjustable carrier frequency with 16 KHz minimum upper limit.
- g. A built-in or external line reactor with 3 percent minimum impedance to protect the DC bus capacitors and rectifier section diodes, reduce power line transient voltage, line notching, DC bus over-voltage tripping and improve the inverter over-current and over-voltage conditions.
- h. Historical logging information and displays:

2.2 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 7, and NEMA ICS 6, with a heater if located outdoors.

2.3 WIRES AND CABLES

All wires and cables must conform to NEMA 250, NEMA ICS 7, NFPA 70.

2.4 NAMEPLATES

Nameplates external to NEMA enclosures must conform with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manufacturer's standard, permanent nameplates for internal areas of enclosures.

2.5 SOURCE QUALITY CONTROL

2.5.1 ASD Test Plan

To ensure quality, each ASD must be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test plans.

2.5.2 ASD Test Report

To ensure quality, each ASD must be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test reports.

PART 3 EXECUTION

3.1 INSTALLATION

Per NEMA ICS 3.1, install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop drawings. A field representative of the drive manufacturer must supervise the installation of all equipment, and wiring.

3.2 GROUNDING

Per NEMA ICS 7.2, ASD must be solidly grounded to the main distribution.

3.3 FIELD QUALITY CONTROL

Specified products must be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. Submit a signed copy of the test results, certifying proper system operation before scheduling tests.

3.3.1 ASD Test

A proposed test plan must be submitted to the contracting officer at least 28 calendar days prior to proposed testing for approval. The tests must conform to NEMA ICS 1, NEMA ICS 7, and all manufacturer's safety regulations. The Government reserves the right to witness all tests and review any documentation. Inform the Government at least 14 working days prior to the dates of testing. Perform the ASD test engaging a qualified testing agency's field supervisor currently certified by NETA to supervise on-site testing.

3.3.2 Performance Verification Tests

"Performance Verification Test" plan must provide the step by step procedure required to establish formal verification of the performance of the ASD. Compliance with the specification requirements must be verified by inspections, review of critical data, demonstrations, and tests. The Government reserves the right to witness all tests, review data, and request other such additional inspections and repeat tests as necessary to ensure that the system and provided services conform to the stated requirements. Inform the Government 14 calendar days prior to the date the test is to be conducted.

3.3.3 Endurance Test

Immediately upon completion of the performance verification test, the endurance test must commence. The system must be operated at varying rates for not less than 192 consecutive hours, at an average effectiveness level of 0.9998, to demonstrate proper functioning of the complete PCS. Continue the test on a day-to-day basis until performance standard is met. The contractor is not allowed in the building during the endurance test. The system must respond as designed.

3.4 DEMONSTRATION

3.4.1 Training

Coordinate training requirements with the Contracting Officer. Provide video tapes, if available, of all training provided to the Government for subsequent use in training new personnel. Provide all training aids, texts, and expendable support material for a self-sufficient presentation shall be provided, the amount of which to be determined by the contracting officer.

3.4.1.1 Instructions to Government Personnel

Provide the services of competent instructors with minimum two-year field experience with the operation and maintenance of similar ASDs who will give full instruction to designated personnel in operation, maintenance, calibration, configuration, and programming of the complete control system. Orient the training specifically to the system installed. Instructors must be thoroughly familiar with the subject matter they are to teach. The number of training days of instruction furnished must be as specified. A training day is defined as eight hours of instruction, including two 15-minute breaks and excluding lunch time; Monday through Friday. Provide a training manual for each student at each training phase which describes in detail the material included in each training program. Provide one additional copy for archiving. Provide equipment and materials required for classroom training. Provide a list of additional related courses, and offers, noting any courses recommended. List each training course individually by name, including duration, approximate cost per person, and location of course. Unused copies of training manuals must be turned over to the Government at the end of last training session.

3.4.1.2 Operating Personnel Training Program

Provide one 2-hour training session at the site at a time and place mutually agreeable between the Contractor and the Government. Provide session to train 4 operation personnel in the functional operations of the system and the procedures that personnel will follow in system operation. This training shall include:

- a. System overview
- b. General theory of operation
- c. System operation
- d. Alarm formats
- e. Failure recovery procedures

f. Troubleshooting

3.4.1.3 Engineering/Maintenance Personnel Training

Accomplish the training program as specified. Training must be conducted on site at a location designated by the Government. Provide a one-day training session to train four engineering personnel in the functional operations of the system. This training must include:

- a. System overview
- b. General theory of operation
- c. System operation
- d. System configuration
- e. Alarm formats
- f. Failure recovery procedures
- g. Troubleshooting and repair
- h. Maintenance and calibration
- i. System programming and configuration

-- End of Section --

SECTION 26 32 15.00

ENGINE-GENERATOR SET STATIONARY 15-2500 KW, WITH AUXILIARIES
05/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(2020) Power Piping
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M	(2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A181/A181M	(2014; R 2020) Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A234/A234M	(2019) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM D975	(2020) Standard Specification for Diesel Fuel Oils

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

EGSA 101P	(1995) Performance Standard for Engine Driven Generator Sets
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1	(2000; R 2011) General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation
IEEE 43	(2013) Recommended Practice for Testing Insulation Resistance of Rotating Machinery
IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE 115	(2019) Guide for Test Procedures for Synchronous Machines: Part I Acceptance and Performance Testing; Part II Test Procedures and Parameter Determination for Dynamic Analysis
IEEE 120	(1989; R 2007) Master Test Guide for Electrical Measurements in Power Circuits
IEEE 519	(2014) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C50.12	(2005; R 2010) Standard for Salient Pole 50 Hz and 60 Hz Synchronous Generators and Generation/Motors for Hydraulic Turbine Applications Rated 5 MVA and above
IEEE C57.13	(2016) Requirements for Instrument Transformers
IEEE C57.13.1	(2006; R 2012) Guide for Field Testing of Relaying Current Transformers

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code
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INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 3046	(2002, 2006, 2009, 2001) Reciprocating Internal Combustion Engines - Performance--Part 1, 3, 4, 5, 6
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ISO 8528 (1993; R 2018) Reciprocating Internal
Combustion Engine Driven Alternating
Current Generator Sets--Part 1, 2, 3, 4,
5, 6, 7, 8, 9, 10, 12, 13

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-58 (2018) Pipe Hangers and Supports -
Materials, Design and Manufacture,
Selection, Application, and Installation

MSS SP-80 (2019) Bronze Gate, Globe, Angle and Check
Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1993; R 2016) Industrial Control and
Systems: Enclosures

NEMA MG 1 (2018) Motors and Generators

NEMA PB 1 (2011) Panelboards

NEMA PB 2 (2011) Deadfront Distribution Switchboards

NEMA/ANSI C12.11 (2006; R 2019) Instrument Transformers for
Revenue Metering, 10 kV BIL through 350 kV
BIL (0.6 kV NSV through 69 kV NSV)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30 (2021) Flammable and Combustible Liquids
Code

NFPA 37 (2018) Standard for the Installation and
Use of Stationary Combustion Engines and
Gas Turbines

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 99 (2021) Health Care Facilities Code

NFPA 110 (2016) Standard for Emergency and Standby
Power Systems

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE ARP892 (1965; R 1994) DC Starter-Generator, Engine

SAE J537 (2016) Storage Batteries

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-461 (2015; Rev G) Requirements for the Control
of Electromagnetic Interference

Characteristics of Subsystems and Equipment

UFC 3-301-01

(2019) Structural Engineering

UNDERWRITERS LABORATORIES (UL)

UL 467

(2013; Reprint Jun 2017) UL Standard for
Safety Grounding and Bonding Equipment

UL 489

(2016; Rev 2019) UL Standard for Safety
Molded-Case Circuit Breakers, Molded-Case
Switches and Circuit-Breaker Enclosures

UL 1236

(2015; Reprint Mar 2016) UL Standard for
Safety Battery Chargers for Charging
Engine-Starter Batteries

UL 1437

(2006) Electrical Analog Instruments -
Panel Board Types

1.2 RELATED MATERIALS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, and Section 26 08 00
APPARATUS INSPECTION AND TESTING apply to this section, except as modified
herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S"
classification. Submittals not having a "G" or "S" classification are for
Contractor Quality Control approval. Submit the following in accordance
with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Engine-Generator Set and Auxiliary Equipment; G

Auxiliary Systems; G

Detailed Drawings; G

Acceptance; G

SD-03 Product Data

Harmonic Requirements; G

Engine-Generator Set Efficiencies; G

Emissions; G

Filters; G

Special tools; G

Remote Alarm Annunciator; G

Engine-Generator Parameter Schedule

Heat Exchanger

Generator

Manufacturer's Catalog

Site Welding

Spare Parts

Instructions; G

Experience

Field Engineer

General Installation

Exciter

SD-05 Design Data

Performance Criteria

Sound Limitations; G

Power Factor

Time-Delay on Alarms

Cooling System

Vibration Isolation

Battery Charger

Capacity Calculations for Engine-Generator Set; G

Torsional Vibration Stress Analysis Computations; G

Capacity Calculations for Batteries; G

Turbocharger Load Calculations; G

SD-06 Test Reports

Performance Tests

Factory Inspection and Tests

Factory Tests

Onsite Inspection and Tests; G

Acceptance Checks and Tests; G

Functional Acceptance Tests; G

Maintenance Procedures; G

Operation and Maintenance Manuals; G

Inspections; G

Functional Acceptance Test Procedure; G

SD-07 Certificates

Cooling System

Vibration Isolation

Reliability and Durability

Start-Up Engineer; G

Instructor's Qualification Resume; G

Sound Limitations

Site Visit

Current Balance

Materials and Equipment

Factory Inspection and Tests

SD-09 Manufacturer's Field Reports

Engine Tests; G

Generator Tests; G

Assembled Engine-Generator Set Tests; G

SD-10 Operation and Maintenance Data

Preliminary Assembled Operation and Maintenance Manuals; G

Submit in accordance with Section 01 78 23 OPERATION AND
MAINTENANCE DATA and the paragraph ASSEMBLED OPERATION AND
MAINTENANCE MANUALS.

SD-11 Closeout Submittals

Training Plan; G

1.4 QUALITY ASSURANCE

1.4.1 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, NEMA, etc., the design, fabrication and installation must also conform to the code.

1.4.2 Site Welding

Weld structural members in accordance with Section 05 05 23.16 STRUCTURAL WELDING. For all other welding, qualify procedures and welders in accordance with ASME BPVC SEC IX.

- a. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1.
- b. Submit a copy of qualifying procedures and a list of names and identification symbols of qualified welders and welding operators.
- c. Submit a letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their identification symbols.
- d. Perform welder qualification tests for each welder whose qualifications are not in compliance with the referenced standards. Notify the Contracting Officer 24 hours in advance of qualification tests which must be performed at the work site, if practical.
- e. The welder or welding operator must apply the personally assigned symbol near each weld made as a permanent record.

1.4.3 Vibration Limitation

Limit the maximum engine-generator set vibration in the horizontal, vertical, and axial directions to 6 mils (peak-peak RMS), with an overall velocity limit of 0.95 inches/second RMS, at rated speed for all loads through 110 percent of rated speed. The engine-generator set must be provided with vibration isolation in accordance with the manufacturer's standard recommendation. Where the vibration isolation system does not secure the base to the structure floor or unit foundation, provide seismic restraints in accordance with the seismic parameters specified.

1.4.4 Torsional Analysis

Submit torsional analysis including prototype testing or calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus/minus 10 percent.

1.4.5 Performance Data

Submit vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Also submit a description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

1.4.6 Seismic Requirements

Seismic requirements must be in accordance with UFC 3-301-01.

1.4.7 Experience

Each component manufacturer must have a minimum of 3 years' experience in

the manufacture, assembly and sale of components used with stationary engine-generator sets for commercial and industrial use. The engine-generator set manufacturer/assembler must have a minimum of 3 years' experience in the manufacture, assembly and sale of stationary engine-generator sets for commercial and industrial use. Submit a statement showing and verifying these requirements.

1.4.8 Field Engineer

The engine-generator set manufacturer or assembler must furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer must have attended the engine generator manufacturer's training courses on installation and operation and maintenance of engine generator sets. Submit a letter listing the qualifications, schools, formal training, and experience of the field engineer.

1.4.9 Detailed Drawings

Submit detailed drawings showing the following:

- a. Base-mounted equipment, complete with base and attachments, including anchor bolt template and recommended clearances for maintenance and operation.
- b. Starting system.
- c. Fuel system.
- d. Cooling system.
- e. Exhaust system.
- f. Electric wiring of relays, breakers, programmable controllers, and switches including single line and wiring diagrams.
- g. Lubrication system, including piping, pumps, strainers, filters, heat exchangers for lube oil and turbocharger cooling, electric heater, controls and wiring.
- h. Location, type, and description of vibration isolation devices for all applications.
- i. The safety system, including wiring schematics.
- j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and instrumentation.
- k. Panel layouts.
- l. Mounting and support for each panel and major piece of electrical equipment.
- m. Engine-generator set rigging points and lifting instructions.

1.4.10 Auxiliary Systems Engine-Generator Set and Auxiliary Equipment Drawing Requirements

Submit drawings pertaining to the engine-generator set and auxiliary equipment, including but not limited to the following:

- a. Certified outline, general arrangement (setting plan), and anchor bolt details. Show total weight and center of gravity of assembled equipment on the steel sub-base.
- b. Detailed elementary, schematic wiring, and interconnection diagrams of the engine starting system, jacket coolant heating system, engine protective devices, engine alarm devices, engine speed governor system, generator and excitation system, and other integral devices.
- c. Detailed elementary, schematic wiring; and interconnection diagrams of the fuel system, starting battery system, engine-generator control panel, generator circuit breaker, and remote alarm annunciator.
- d. Dimensional drawings or catalog cuts of exhaust silencers, radiator, fuel day tanks, fuel oil cooler, valves and pumps, intake filters, vibration isolators, and other auxiliary equipment not integral with the engine-generator set.

1.4.11 Vibration Isolation System Certification

Submit certification from the manufacturer that the vibration isolation system will reduce the vibration to the limits specified in the paragraph VIBRATION ISOLATION.

1.5 DELIVERY, STORAGE, AND HANDLING

Properly protect materials and equipment, in accordance with the manufacturers recommended storage procedures, before, during, and after installation. Protect stored items from the weather and contamination. During installation, cap piping and similar openings to keep out dirt and other foreign matter.

Deliver equipment on pallets or blocking wrapped in heavy-duty plastic, sealed to protect parts and assemblies from moisture and dirt. Protect and prepare batteries for shipment as recommended by the battery manufacturer. Store auxiliary equipment at the site in covered enclosures, protected from atmospheric moisture, dirt, and ground water.

1.6 EXTRA MATERIALS

Provide two sets of special tools and two sets of filters required for maintenance. Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. One handset must be provided for each electronic governor when required to indicate and/or change governor response settings. Furnish 4 liters one gallon of identical paint used on engine-generator set in manufacturer's sealed container with each engine-generator set.

Wrenches and tools specifically designed and required to work on the new equipment, which are not commercially available as standard mechanic's tools, must be furnished to the Contracting Officer.

Provide proposed operating instructions for the engine-generator set and

auxiliary equipment laminated between matte-surface thermoplastic sheets and suitable for placement adjacent to corresponding equipment. After approval, install operating instructions where directed.

1.7 MAINTENANCE SERVICES

Submit the operation and maintenance manuals and have them approved prior to commencing onsite tests.

1.7.1 Operation Manual

Provide three copies of the operation manual in 8-1/2 by 11 inch three-ring binders. Sections must be separated by heavy plastic dividers with tabs which identify the material in the section. Fold drawings with the title block visible, and placed in 8-1/2 by 11 inch plastic pockets with reinforced holes. The manual must include:

- a. Step-by-step procedures for system startup, operation, and shutdown;
- b. Drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems with their controls, alarms, and safety systems;
- c. Procedures for interface and interaction with related systems to include automatic transfer switches uninterruptible power supplies.

1.7.2 Maintenance Manual

Provide three copies of the manufacturers standard maintenance manual. Separate each section by a heavy plastic divider with tabs. Fold drawings with the title block visible, and placed in plastic pockets with reinforced holes. The manual must include:

- a. Procedures for each routine maintenance item.
- b. The manufacturer's recommended maintenance schedule.
- c. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components.
- d. A list of spare parts for each piece of equipment and a complete list of materials and supplies needed for operation.

1.7.3 Assembled Operation and Maintenance Manuals

The contents of the assembled operation and maintenance manuals must include the manufacturer's O&M information required by the paragraph SD-10, OPERATION AND MAINTENANCE DATA and the manufacturer's O&M information specified in Section 26 36 23 AUTOMATIC TRANSFER SWITCHES AND BY-PASS/ISOLATION SWITCH.

- a. Manuals must be in separate books or volumes, assembled and bound securely in durable, hard covered, water resistant binder, and indexed by major assembly and components in sequential order.
- b. A table of contents (index) must be made part of the assembled O&M. The manual must be assembled in the order noted in table of contents.

- c. The cover sheet or binder on each volume of the manuals must be identified and marked with the words, "Operation and Maintenance Manual."

1.8 SITE CONDITIONS

Protect the components of the engine-generator set, including cooling system components, pumps, fans, and similar auxiliaries when not operating and provide components capable of the specified outputs in the following environment:

- a. Site Location: NSN-Newport, Rhode Island
- b. Site Elevation: 21 feet above mean sea level.
- c. Ambient Temperatures:
 - (1) Maximum 90.1 degrees F dry bulb, 85.2 degrees F wet bulb.
 - (2) Minimum 72 degrees F dry bulb.
- d. Design Wind Velocity: 130 mph.
- e. Seismic Zone: Zone 2A as defined by ICC IBC.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

- a. Provide and install each engine-generator set complete and totally functional, with all necessary ancillary equipment to include: air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine-generator set must satisfy the requirements specified in the Engine-Generator Parameter Schedule. Submit certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.
- b. Provide each engine-generator set consisting of one engine, one generator, and one exciter mounted, assembled, and aligned on one base; and all other necessary ancillary equipment which may be mounted separately. Assemble sets having a capacity of 750 kW or smaller and attach to the base prior to shipping. Sets over 750 kW capacity may be shipped in sections. Provide set components that are environmentally suitable for the locations shown and that are the manufacturer's standard product offered in catalogs for commercial or industrial use. Provide a generator strip heater for moisture control when the generator is not operating. Identify any nonstandard products or components and the reason for their use.

2.1.1 Engine-Generator Parameter Schedule

Engine-Generator Set and Auxiliary Equipment Capacity Calculations for
Engine-Generator Set

ENGINE-GENERATOR PARAMETER SCHEDULE	
Identification	Make/Model
Electrical Characteristics	
Power Rating	Emergency Standby Gross bhp rating / Net brake power rating 130 kW at 0.8 power factor
Governor Type	Type Make / Model Isochronous
Service Load	112.5 kVA (maximum) 107 kVA (continuous)
Motor Starting kVA (Max.)	112.5 kVA
Power Factor	lagging
Engine-Generator Applications	stand-alone
Voltage Regulation (No Load to Full Load)(Stand-alone applications)	plus or minus 2 percent (maximum)
Voltage Regulation (steady state)	plus or minus 0.5 percent
Frequency	60 Hz
Voltage	480 volts
Phases	3 Phase, Wye

ENGINE-GENERATOR PARAMETER SCHEDULE	
Minimum Generator Sub-transient Reactance	12 percent Sub-transient
Max Step Load Increase	100 percent of Service Load at .93 PF
Maximum Voltage Deviation with Step Load Increase	15 percent of rated voltage
Maximum Frequency Deviation with Step Load Increase	15 percent of rated frequency
Max Step Load Decrease (without shutdown)	100 percent of Service Load at 0.8 PF
Frequency Bandwidth (steady state)	plus or minus 0.25 percent
Frequency Regulation (droop) (No Load to Full Load)	15 percent (maximum)
Capacity Calculations	
Calculations must verify that the engine-generator set power rating is adequate for the following load conditions: Refer to generator calculation.	
Other Load	kW at 0.8 power factor
Capacity Calculations for Batteries	
Calculation must verify that the engine starting battery capacity exceeds dc power requirements.	
Mechanical Characteristics	
Engine Description	Strokes/cycle Number of cylinders Bore and Stroke, inches

ENGINE-GENERATOR PARAMETER SCHEDULE	
Engine Speed	1800 rpm
Heat Exchanger Type	fin-tube (radiator)
Engine Cooling Type	water/ethylene glycol
Intercooler Type	Air-to-Air
Induction Method	Turbocharged
Max Time to Start and be Ready to Assume Load	10 seconds
Max Summer Outdoor Temp (Ambient)	98 degrees F
Min Winter Outdoor Temp (Ambient)	11 degrees F
Installation Elevation	27 above sea level
Engine-Generator Set Efficiencies	
Fuel Consumption	At 0.8 power factor, Gallons / hour for: 1 / 2 load 3 / 4 load Full Load
Generator Efficiency	At 0.8 power factor,(per cent) for: 1 / 2 load 3 / 4 load Full Load

ENGINE-GENERATOR PARAMETER SCHEDULE	
	based on optimum coolant temperature to and from engine
Engine-Generator Set Emissions Data	
Exhaust Temperature	895 Degrees F at full load
Total Heat Rejected	Btu per hr, at full load to: Jacket Coolant System
Emissions	lb per hr, at full load Total Suspended Particulate Particulate Matter with an average aerodynamic diameter of 10 microns Sulfur Dioxides Nitrogen Oxides (as NO2) Carbon Monoxide Volatile Organic Compounds
Visible Emissions	Percent opacity at full load
Torsional Vibration Stress Analysis Computations	

ENGINE-GENERATOR PARAMETER SCHEDULE

Torsional vibrational stresses in the crankshaft and generator shaft of assembled engine and driven generator must not exceed 5000 psi when engine is driving generator at rated speed while assembled unit is loaded to rated engine-generator set power. Computations must be based on a mathematical model of the assembled generator set provided or based on calculations using measured values from tests on a unit identical to the one provided. Calculations based on models of, or measured data from, the unassembled engine and generator will not be acceptable. Calculations must include:

- a. A description of the system relating information pertinent to analysis such as operating speed range and identification plate data.
- b. A mass elastic assembly drawing, showing the arrangement of the units in the generator set and dimensions of shafting, including minimum diameters (or section moduli) of shafting in the system.
- c. A labeled line diagram of the mass elastic system indicating values of masses, stiffness, equivalent lengths, and equivalent diameters including basic assumptions and definition of terms.
- d. Sample computations showing procedures used to obtain resulting stress values.
- e. Computations indicating assembled engine-generator speed of 1800 rpm with assembly loaded to rated generator power and the resulting computed critical torsional stress values in the assembled engine crankshaft and generator shaft.

Turbocharger Load Calculations

NOTE: When the engine-generator set installation includes field installed exhaust system (i.e., the engine-generator set is installed internal to a building in lieu of in a self-contained outdoor enclosure), include the following paragraph.

When the proposed exhaust system layout is different from that shown on the contract drawings, submit calculations showing that the external loads from the exhaust system such as weight and thermal expansion do not exceed the engine manufacturer's maximum allowed forces and moments on the turbocharger.

2.1.2 Rated Output Capacity

2.1.2.1 Performance Class

The voltage and frequency behavior of the generator set must be in accordance with ISO 8528 operating limit values for performance Class G2.

2.1.3 Power Ratings

Power ratings must be in accordance with EGSA 101P.

2.1.4 Transient Response

The engine-generator set governor and voltage regulator must cause the engine-generator set to respond to the maximum step load changes such that output voltage and frequency recover to and stabilize within the operational bandwidth within the transient recovery time. The engine-generator set must respond to maximum step load changes such that the maximum voltage and frequency deviations from bandwidth are not exceeded.

2.1.5 Reliability and Durability

Each standby engine-generator set must have both an engine and a generator capable of delivering the specified power on a standby basis with an anticipated mean time between overhauls of no less than 5,000 hours operating with a load factor of 70 percent. Cite two like engines and two like generators that have performed satisfactorily in a stationary power plant, independent and separate from the physical location of the manufacturer's and assembler's facilities, for standby without any failure to start, including all periodic exercise. Provide like engines and generators that have had no failures resulting in downtime for repairs in excess of 72 hours during two consecutive years of service. Provide engines that are the same model, speed, bore, stroke, number and configuration of cylinders, and rated output capacity. Provide generators that are the same model, speed, pitch, cooling, exciter, voltage regulator and rated output capacity.

Submit a reliability and durability certification letter from the manufacturer and assembler to prove that existing facilities are and have been successfully utilizing the same components proposed to meet this specification, in similar service. Certification may be based on components, i.e. engines used with different models of generators and generators used with different engines, and does not exclude annual technological improvements made by a manufacturer in the basic standard-model component on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets the performance requirements specified. Provide a list with the name of the installations, completion dates, and name and telephone number of a point of contact.

2.1.6 Engine-Generator Set Enclosure

Provide engine-generator set enclosures that are corrosion resistant and fully weather resistant. The enclosure must contain all set components and provide ventilation to permit operation at Service Load under secured conditions. Provide access doors to controls and equipment requiring periodic maintenance or adjustment. Provide removable panels for access

to components requiring periodic replacement. The enclosure must be capable of being removed without disassembly of the engine-generator set or removal of components other than the exhaust system. The enclosure must reduce the noise of the generator set to within the limits specified in the paragraph SOUND LIMITATIONS.

2.1.7 Vibration Isolation

Provide an engine-generator set with a vibration isolation system in accordance with the manufacturer's standard recommendation. Submit vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor plus description of seismic qualification of the engine-generator mounting, base, and vibration isolation. Submit torsional analysis including prototype testing or and calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus 10 percent. Design and qualify vibration isolation systems as an integral part of the base and mounting system in accordance with the seismic parameters specified. Where the vibration isolation system does not secure the base to the structure floor or unit foundation, provide seismic restraints in accordance with the seismic parameters specified.

2.1.8 Harmonic Requirements

Non-linear loads to be served by each engine-generator set are as indicated. The maximum linear load demand (kVA at PF) when non-linear loads will also be in use is as indicated.

2.1.9 Starting Time Requirements

Upon receipt of a signal to start, each engine generator set will start, reach rated frequency and voltage and be ready to assume load within the time specified. For standby sets used in emergency power applications, each engine generator set will start, reach rated frequency and voltage, and power will be supplied to the load terminals of the automatic transfer switch within the starting time specified.

2.2 NAMEPLATES

Provide the manufacturer's name, type or style, model or serial number and rating on a plate secured to the equipment for each major component of this specification. Provide plates and tags sized so that inscription is readily legible to operating or maintenance personnel and securely mounted to or attached in proximity of their identified controls or equipment. Lettering must be normal block lettering, a minimum of 0.25 inch high. As a minimum, provide nameplates for:

Engines	Relays
Generators	Transformers (CT & PT)
Regulators	Day tanks
Pumps and pump motors	Governors

Generator Breaker

Air Starting System

Economizers

Heat exchangers (other than base mounted)

Where the following equipment is not provided as a standard component by the engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger

Heaters

Switchboards

Exhaust mufflers

Switchgear

Silencers

Battery

Exciters

2.2.1 Materials

Construct ID plates and tags of 16 gage minimum thickness bronze or stainless steel sheet metal engraved or stamped with inscription. Construct plates and tags not exposed to the weather or high operational temperature of the engine of laminated plastic, 0.125 inch thick, matte white finish with black center core, with lettering accurately aligned and engraved into the core.

2.2.2 Control Devices and Operation Indicators

Provide ID plates or tags for control devices and operation indicators, including valves, off-on switches, visual alarm annunciators, gages and thermometers, that are required for operation and maintenance of provided mechanical systems. Plates or tags must be minimum of 0.5 inch high and 2 inches long and must indicate component system and component function.

2.2.3 Equipment

Provide ID plates of a minimum size of high and 5 inches long on provided equipment indicating the following information:

- a. Manufacturer's name, address, type and model number, serial number, and certificate of compliance with applicable EPA mission standards;
- b. Contract number and accepted date;
- c. Capacity or size;
- d. System in which installed; and
- e. System which it controls.

2.3 SAFETY DEVICES

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices such

that proper operation of the equipment is not impaired.

2.4 MATERIALS AND EQUIPMENT

Submit certification stating that where materials or equipment are specified to comply with requirements of UL, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

2.4.1 Circuit Breakers, Low Voltage

UL 489.

2.4.2 Filter Elements

Provide the manufacturer's standard fuel-oil, lubricating-oil, and combustion-air filter elements.

2.4.3 Instrument Transformers

NEMA/ANSI C12.11.

2.4.4 Revenue Metering

IEEE C57.13.

2.4.5 Pipe (Fuel/Lube-Oil, Compressed Air, Coolant, and Exhaust)

ASTM A53/A53M, or ASTM A106/A106M steel pipe. Pipe smaller than 2 inches must be Schedule 80. Pipe 2 inches and larger must be Schedule 40.

2.4.5.1 Flanges and Flanged Fittings

ASTM A181/A181M, Class 60, or ASME B16.5, Grade 1, Class 150.

2.4.5.2 Pipe Welding Fittings

ASTM A234/A234M, Grade WPB or WPC, Class 150 or ASME B16.11, 3000 lb.

2.4.5.3 Threaded Fittings

ASME B16.3, Class 150.

2.4.5.4 Valves

MSS SP-80, Class 150.

2.4.5.5 Gaskets

Manufacturer's standard.

2.4.6 Pipe Hangers

MSS SP-58.

2.4.7 Electrical Enclosures

NEMA ICS 6.

2.4.7.1 Switchboards

NEMA PB 2.

2.4.7.2 Panelboards

NEMA PB 1.

2.5 ENGINE

Each engine must operate on natural gas conforming to ASTM D975, must be designed for stationary applications and must be complete with ancillaries. The engine must be a standard production model shown in the manufacturer's catalog describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate complete specification compliance. The engine must be naturally aspirated, supercharged, or turbocharged. The engine must be 2- or 4-stroke-cycle. The engine must be vertical in-line, V- or opposed-piston type, with a solid cast block or individually cast cylinders. The engine must have a minimum of two cylinders. Opposed-piston type engines must have more than four cylinders. Each block must have a coolant drain port. Equip each engine with an over-speed sensor.

2.5.1 Sub-base Mounting

Mount each engine-generator set on a structural steel sub-base sized to support the engine, generator, and necessary accessories, auxiliaries and control equipment to produce a complete self-contained unit as standard with the manufacturer. Design the structural sub-base to properly support the equipment and maintain proper alignment of the engine-generator set in the specified seismic zone. In addition, provide sub-base with both lifting rings and jacking pads properly located to facilitate shipping and installation of the unit. Factory align engine and generator on the sub-base and securely bolt into place in accordance with the manufacturer's standard practice. Crankshaft must have rigid coupling for connection to the generator.

2.5.2 Assembly

Completely shop assemble each engine-generator set on its structural steel sub-base. Paint entire unit with manufacturer's standard paints and colors. After factory tests and before shipping, thoroughly clean and retouch painting as necessary to provide complete protection.

2.5.3 Turbocharger

If required by the manufacturer to meet the engine-generator set rating, provide turbine type driven by exhaust gas from engine cylinders, and direct connected to the blower supplying air to the engine intake manifold.

2.5.4 Intercooler

Provide manufacturer's standard intercooler for engine size specified.

2.5.5 Crankcase Protection

2.5.6 Miscellaneous Engine Accessories

Provide the following engine accessories where the manufacturer's standard design permits:

- a. Piping on engine to inlet and outlet connections, including nonstandard companion flanges.
- b. Structural steel sub-base and vibration isolators, foundation bolts, nuts, and pipe sleeves.
- c. Level jack screws or shims, as required.
- d. Rails, chocks, and shims for installation of sub-base on the foundation.
- e. Removable guard, around fan. Support guard, on engine sub-base, to suit manufacturer's standard.

2.5.7 Intercooler

Provide manufacturer's standard intercooler for engine size specified.

2.6 FUEL SYSTEM

Provide fuel system conforming to the requirements of NFPA 30 and NFPA 37 and containing the following elements.

The fuel system shall be integral with the engine. In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted. Flexible fuel lines shall be minimally rated for 300 degrees F and 100 psi. The fuel pressure available at the engine input should be in the range of 2.7-3.5 kPa.

2.7 LUBRICATION

Provide engine with a separate lube-oil system conforming to NFPA 30 and NFPA 37. Pressurize each system by engine-driven pumps. Regulate system pressure as recommended by the engine manufacturer. Provide a pressure relief valve on the crankcase for closed systems. Vent the crankcase in accordance with the manufacturer's recommendation. Do not vent the crankcase to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, must be piped to vent to the outside. The system must be readily accessible for service such as draining, refilling, etc. Each system must permit addition of oil and have oil-level indication with the set operating. The system must utilize an oil cooler as recommended by the engine manufacturer.

2.7.1 Lube-Oil Filter

Provide one full-flow filter for each pump. The filter must be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. Mark inlet and outlet connections.

2.7.2 Lube-Oil Sensors

Equip each engine with lube-oil pressure sensors located downstream of the filters and provide signals for required indication and alarms. Submit two complete sets of filters, required for maintenance, supplied in a suitable storage box. Provide these filters in addition to filters replaced after testing.

2.8 COOLING SYSTEM

Provide each engine with its own cooling system to operate automatically while its engine is running. The cooling system coolant must use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified.

2.8.1 Heat Exchanger

Provide heat exchanger with the size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted for the maximum summer outdoor design temperature and site elevation. Submit manufacturer's data to quantify heat rejected to the space with the engine generator set at rated capacity. Provide heat exchangers that are corrosion resistant, suitable for service in ambient conditions of application.

2.8.2 Expansion Tank

The cooling system must include an air expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components.

2.8.3 Thermostatic Control Valve

Provide a modulating type, thermostatic control valve in the coolant system to maintain the coolant temperature range submitted in paragraph SUBMITTALS.

2.8.4 Temperature Sensors

Equip each engine with coolant temperature sensors. Provide temperature sensors with signals for pre-high and high indication and alarms.

2.9 SOUND LIMITATIONS

Submit sound power level data for the packaged unit operating at 100 percent load in a free field environment. The data should demonstrate compliance with the sound limitation requirements of this specification. Submit certification from the manufacturer stating that the sound emissions meet the specification. Do not exceed the following sound pressure levels in any of the indicated frequencies when measured in a free field at a radial distance of 22.9 feet 7 meters at 45 degrees apart in all directions when operating at 100 percent load.

Frequency Band (Hz)	Maximum Acceptable Sound Level (Decibels)
31	44
63	65
125	71
250	74
500	77
1,000	73
2,000	69
4,000	65
8,000	57

2.10 AIR INTAKE EQUIPMENT

Locate filters and silencers in locations that are convenient for servicing. Provide high-frequency filter type silencers and locate in the air intake system as recommended by the engine manufacturer. Provide silencer to reduce the noise level at the air intake so that the indicated pressure levels specified in paragraph SOUND LIMITATIONS will not be exceeded. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Provide copper or rubber expansion elements in air-intake lines.

Provide intake filter assemblies for each engine of the oil bath or dry type, as standard with the manufacturer. Filters must be capable of removing a minimum of 92 percent of dirt and abrasive 3 microns and larger from intake air. Size filters to suit engine requirements at 100 percent of rated full load. Design unit for field access for maintenance purposes.

2.11 EXHAUST SYSTEM

Provide a separate and complete system for each engine. Support piping to minimize vibration. Where a V-type engine is provided, use a V-type connector, with necessary flexible sections and hardware, to connect the engine exhaust outlets.

2.11.1 Flexible Sections and Expansion Joints

Provide a flexible section at each engine and an expansion joint at each muffler. Provide flexible sections and expansion joints that have flanged connections. Provide flexible sections made of convoluted seamless tube without joints or packing. Provide bellows type expansion joints. Provide stainless steel expansion and flexible elements suitable for engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Provide expansion and flexible elements that are capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.12 EMISSIONS

The finished installation must comply with Federal, state, and local regulations and restrictions regarding the limits of emissions, as listed here. Submit certification from the engine manufacturer stating that the engine exhaust emissions meet the federal, state, and local regulations and restrictions specified. At a minimum this certification must include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HAPs).

2.13 STARTING SYSTEM

Provide starting system for standby engine generator sets used in emergency applications in accordance with NFPA 99 and NFPA 110 and as follows.

2.13.1 Controls

Provide an engine control switch with functions including: run/start (manual), off/reset, and, automatic mode. Provide start-stop logic for adjustable cycle cranking and cool-down operation. Arrange the logic for manual starting and fully automatic starting in accordance with paragraph AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION. Provide electrical starting systems with an adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.

2.13.2 Capacity

Provide starting system with sufficient capacity, at the maximum outdoor summer temperature specified to crank the engine without damage or overheating. The system must provide a minimum of three cranking periods with 15 second intervals between cranks. Each cranking period must have a maximum duration of 15 seconds. Starting must be accomplished using an adequately sized dc starter system with a positive shift solenoid to engage the starter motor and to crank the engine continuously for 60 seconds without overheating.

2.13.3 Electrical Starting

Manufacturers recommended dc system, utilizing a negative circuit ground. Starting motors must be in accordance with SAE ARP892.

2.13.3.1 Battery

Provide a starting battery system including the battery, battery rack, intercell connectors, spacers, automatic battery charger with overcurrent protection, metering and relaying. Provide battery in accordance with SAE J537. Size critical system components (rack, protection, etc.) to withstand the seismic acceleration forces specified. Provide lead-acid battery with sufficient capacity, at the minimum outdoor and maximum outdoor temperature specified, to provide the specified cranking periods. Valve-regulated lead-acid batteries are not acceptable.

Provide maintenance free, sealed, lead-acid, SAE Type D engine starting batteries. Batteries must have sufficient capacity to provide 60 seconds of continuous cranking of the engine in an ambient temperature as indicated.

2.13.3.2 Battery Charger

Provide a current-limiting battery charger, conforming to UL 1236, that automatically recharges the batteries. Submit battery charger sizing calculations. The charger must be capable of an equalize charging rate for recharging fully depleted batteries within 24 hours and a floating charge rate for maintaining the batteries at fully charged condition. Provide an ammeter to indicate charging rate. Provide a voltmeter to indicate charging voltage. Provide a timer for the equalize charging-rate setting. A battery is considered to be fully depleted when the output voltage falls to a value which will not operate the engine generator set and its components.

Provide 120 volt ac, enclosed, automatic equalizing, dual-rate, solid-state, constant voltage type battery charger with automatic ac line compensation. DC output must be voltage regulated and current limited. Charger must have two ranges, float and equalize, and must provide continuous taper charging. The charger must have a continuous output rating of not less than 10 amperes and must be sized to recharge the engine starting batteries in a minimum of 8 hours while providing the control power needs of the engine-generator set. Enclosure must be NEMA ICS 6, Type 1. The following accessories must be included:

- a. DC ammeter
- b. DC voltmeter
- c. Equalize light
- d. AC on light
- e. Low voltage light
- f. High voltage light
- g. Equalize test button/switch
- h. AC circuit breaker
- i. Low dc voltage alarm relay
- j. High dc voltage alarm relay
- k. Current failure relay
- l. AC power failure relay

2.13.4 Storage Batteries

Provide storage batteries of suitable rating and capacity to supply and maintain power for the remote alarm annunciator for a period of 90 minutes minimum without the voltage applied falling below 87.5 percent of normal. Provide a 120 volt ac automatic battery charger.

2.13.5 Starting Aids

Provide one or more of other following methods to assist engine starting.

2.13.5.1 Jacket-Coolant Heaters

Mount a thermostatically controlled electric heater in the engine coolant jacketing to automatically maintain the coolant within plus or minus 3 degrees F of the control temperature. The heater must operate independently of engine operation so that starting times are minimized. Power for the heaters must be 120 volts ac. Include necessary equipment, piping, controls, wiring, and accessories.

2.13.5.1.1 Prime Rated Sets

The control temperature must be the higher of the manufacturer's recommended temperature or the minimum coolant inlet temperature of the engine recommended in paragraph SUBMITTALS.

2.13.5.1.2 Standby Rated Sets

The control temperature must be the temperature recommended by the engine manufacturer to meet the starting time specified at the minimum winter outdoor temperature.

2.13.6 Exerciser

Provide exerciser in accordance with Section 26 36 23 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.14 GOVERNOR

Provide a forward acting type engine speed governor system. Steady-state frequency band and frequency regulation (droop) must be in accordance with the operating limit values of the performance class specified in the paragraph PERFORMANCE CLASS.

Provide engine with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100 percent of rated output capacity. Configure the governor for safe manual adjustment of the speed/frequency during operation of the engine-generator set, without special tools, from 90 to 110 percent of the rated speed/frequency, over a steady state load range of 0 to 100 percent or rated capacity. Submit two complete sets of special tools required for maintenance (except for electronic governor handset). Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. Provide a suitable tool box for tools. Provide one handset for each electronic governor when required to indicate and/or change governor response settings. Maintain the midpoint of the frequency bandwidth at the same value for steady-state loads over the range of zero to 100 percent of rated output capacity for isochronous governors.

2.15 GENERATOR

Provide synchronous type, one or two bearing, generator conforming to the performance criteria in NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Submit calculations of the engine and generator output power capability, including efficiency and parasitic load data. Provide Class H insulation.

- a. Select NEMA MG 1, Part 16, standby duty, and temperature rise of 130

degrees C for engine-generator sets which are expected to operate for less than 300 hours per year. Select NEMA MG 1, Part 22, continuous duty, and temperature rise of 105 degrees C for engine-generator sets expected to operate 300 hours or greater per year or rated 300 kW and above.

- b. Select 2/3 pitch design option for engine-generator sets rated 300 kW and above.
- c. Select 10-12 lead re-connectable for engine-generator sets rated 300 kW to 800 kW.
- d. For applications requiring high SCR loading or in harsh environments laden with salts and chemicals, select vacuum pressure impregnation (VPI) insulated coils. When engine-generator sets are rated 800 kW and larger, also select form wound coils.
- e. Provide salient-pole type, ac, brushless-excited, revolving field, air-cooled, self-ventilated, coupled type, synchronous generator conforming to NEMA MG 1, Part 16, and IEEE C50.12. Generator must be rated for standby duty at 100 percent of the power rating of the engine-generator set as specified in paragraph ENGINE-GENERATOR SET RATINGS AND PERFORMANCE. Temperature rise of each of the various parts of the generator must not exceed 105 degrees C as measured by resistance, based on a maximum ambient temperature of 40 degrees C. Winding insulation must be Class H.
- f. Stator: Stator windings must be 2/3 pitch design.
- g. Rotor: The rotor must have connected amortisseur windings.
- h. Grounding: Provide non-corrosive steel grounding pads located at two opposite mounting legs.
- i. Filters: Provide manufacturer's standard generator cooling air filter assembly.
- j. Design generator to protect against mechanical, electrical and thermal damage due to vibration, 25 percent overspeeds, or voltages and temperatures at a rated output capacity of 110 percent for prime applications and 100 percent for standby applications.
- k. Provide generator ancillary equipment meeting the short circuit requirements of NEMA MG 1. Select drip-proof guarded option for generators without weatherproof enclosures.
- l. Submit manufacturer's standard data for each generator (prototype data at the specified rating or above is acceptable), listing the following information:
 - (1) Direct-Axis sub-transient reactance (per unit).
 - (2) The generator kW rating and short circuit current capacity (both symmetric and asymmetric).

2.15.1 Current Balance

At 100 percent rated output capacity, and load impedance equal for each of the 3 phases, the permissible current difference between any 2 phases must

not exceed 2 percent of the largest current on either of the 2 phases. Submit certification stating that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125 percent of rated speed without vibration or damage.

2.15.2 Voltage Balance

At any balanced load between 75 and 100 percent of rated output capacity, the difference in line-to-neutral voltage among the 3 phases must not exceed 1 percent of the average line-to-neutral voltage. For a single phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other 2 phases, the maximum simultaneous difference in line-to-neutral voltage between the phases must not exceed 3 percent of rated line to neutral voltage. The single-phase load requirement must be valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

2.15.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced rated output capacity must not exceed 10 percent. The RMS of all harmonics must be less than 5.0 percent and that of any one harmonic less than 3.0 percent of the fundamental at rated output capacity. Design and configure engine-generator to meet the total harmonic distortion limits of IEEE 519.

2.16 EXCITER

Provide brushless generator exciter. Provide semiconductor rectifiers that have a minimum safety factor of 300 percent for peak inverse voltage and forward current ratings for all operating conditions, including 110 percent generator output at 104 degrees F ambient. The exciter and regulator in combination must maintain generator-output voltage within the limits specified.

Provide a brushless excitation system consisting of an exciter and rotating rectifier assembly, and permanent magnet generator integral with the generator and a voltage regulator. Insulation class for parts integral with the generator must be as specified in paragraph GENERATOR. System must provide a minimum short circuit of 300 percent rated engine-generator set current for at least 10 seconds. Steady state voltage regulation must be in accordance with the operating limit values of the performance class specified in the paragraph PERFORMANCE CLASS.

- a. Exciter and Rotating Rectifier Assembly: Rectifiers must be provided with surge voltage protection.
- b. Permanent Magnet Generator: Provide a voltage spike suppression device for permanent magnet generator (PMG) excitation systems.
- c. Voltage Regulator: Voltage regulator must be solid state or digital, automatic, three-phase sensing, volts per hertz type regulator. Regulator must receive its input power from a PMG. Voltage variation for any 40 degree C change over the operating temperature range must be less than plus or minus 1.0 percent. Operating temperature must be minus 40 degree C to plus 70 degree C. Voltage adjust range must be plus to minus 5.0 percent of nominal. Inherent regulator features

must include over excitation shutdown.

2.16.1 Electromagnetic Interference (EMI) Suppression

Provide as an integral part of the generator and excitation system, EMI suppression complying with MIL-STD-461.

2.17 VOLTAGE REGULATOR

Provide a solid-state voltage regulator, separate from the exciter, for each generator. Maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100 percent of rated output capacity. Configure regulator for safe manual adjustment of the engine-generator voltage output without special tools, during operation, from 90 to 110 percent of the rated voltage over the steady state load range of 0 to 100 percent of rated output capacity. Regulation drift exceeding plus or minus 0.5 percent for an ambient temperature change of 68 degrees F is not acceptable. Reactive droop compensation or reactive differential compensation must load share the reactive load proportionally between sets during parallel operation. Provide voltage regulator with a maximum droop of 2 percent of rated voltage over a load range from 0 to 100 percent of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.18 GENERATOR ISOLATION AND PROTECTION

Provide necessary devices for electrical protection and isolation of each engine-generator set and its ancillary equipment. The generator circuit breaker (IEEE Device 52) ratings must be consistent with the generator rated voltage and frequency, with continuous, short circuit withstand, and interrupting current ratings to match the generator capacity. Provide manually operated generator circuit breaker. Mount a set of surge capacitors at the generator terminals. Provide monitoring and control devices as specified in paragraph GENERATOR PANEL.

The generator circuit breaker must comply with UL 489 requirements for molded case, adjustable thermal magnetic trip type circuit breaker. The circuit breaker continuous current rating must be adequate for the power rating of the engine-generator set and the circuit breaker must be rated to withstand the short circuit current provided by the generator set. Provide circuit breaker in a NEMA ICS 6, Type 1 enclosure mounted on the engine-generator set.

2.18.1 Devices

Provide switches, circuit breakers, switchgear, fuses, relays, and other protective devices as indicated in design.

Furnish with respective pieces of equipment. Motors, controllers, contactors, and disconnects must conform to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide electrical connections under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide controllers and contactors with maximum of 120-volt control circuits, and auxiliary contacts for use with controls furnished. When motors and equipment furnished are larger than size indicated, the cost of providing additional electrical service and related work must be included under this section.

2.19 SAFETY SYSTEM

Provide and install devices, wiring, remote panels, and local panels, etc., as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. Provide a safety system with a self-test method to verify its operability. Provide alarm signals that have manual acknowledgment and reset devices. The alarm signal systems must reactivate for new signals after acknowledgment is given to any signal. Configure the systems so that loss of any monitoring device will be dealt with as an alarm on that system element.

2.19.1 Audible Signal

Provide audible alarm signal sound at a frequency of 70 Hz at a volume of 75 dB at 10 feet. The sound must be continuously activated upon alarm and silenced upon acknowledgment. Locate signal devices as shown.

2.19.2 Visual Signal

The visual alarm signal must be a panel light. The light must be normally off, activated to be blinking upon alarm. The light must change to continuously lit upon acknowledgement. If automatic shutdown occurs, the display must maintain activated status to indicate the cause of failure and must not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms must be red; all other alarms must be amber.

2.19.3 Alarms and Action Logic

2.19.3.1 Shutdown

Accomplish simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator main circuit breakers.

2.19.3.2 Problem

Accomplish activation of the visual signal.

2.19.4 Safety Indications and Shutdowns

Provide a local alarm panel with the following shutdown and alarm functions in accordance with NFPA 110 level 1 mounted either on or adjacent to the engine generator set.

A remote alarm panel is required for audible alarms, e.g., in the control room.

Indicator Function (at battery voltage)	NFPA 99 Level 1 CV S RA	NFPA 110 Level 1 CV S RA	NFPA 110 Level 2 CV S RA
Overcrank	X X X	X X X	X X O
Low water temperature	X NA X	X NA X	X NA O

Indicator Function (at battery voltage)	NFPA 99 Level 1 CV S RA	NFPA 110 Level 1 CV S RA	NFPA 110 Level 2 CV S RA
High engine temperature pre-alarm	X NA X	X NA X	O NA NA
High engine temperature	X X X	X X X	X X O
Low lube oil pressure pre-alarm	X NA X	NA NA NA	NA NA NA
Low lube oil pressure	X X X	X X X	X X O
Overspeed	X X X	X X X	X X O
Low fuel main tank	X NA X	X NA X	O NA O
Low coolant level	X O X	X O X	X O X
EPS supplying load	X NA NA	X NA NA	O NA NA
Control switch not in automatic position	X NA X	X NA X	X NA X
High battery voltage	X NA NA	X NA NA	O NA NA
Low cranking voltage	X NA X	X NA X	O NA NA
Low voltage in battery	X NA NA	X NA NA	O NA NA
Battery charger ac failure	X NA NA	X NA NA	O NA NA
Lamp test	X NA NA	X NA NA	X NA NA
Contacts for local and remote common alarm	X NA X	X NA X	X NA X
Audible alarm silencing switch	NA NA X	NA NA X	NA NA O
Low starting air pressure	X NA NA	X NA NA	O NA NA
Low starting hydraulic pressure	X NA NA	X NA NA	O NA NA
Air shutdown damper when used	X X X	X X X	X X O
Remote emergency stop	NA X NA	NA X NA	NA X NA

Indicator Function (at battery voltage)	NFPA 99 Level 1 CV S RA	NFPA 110 Level 1 CV S RA	NFPA 110 Level 2 CV S RA
<p>Symbology: CV: Control panel-mounted visual. S: Shutdown of EPS indication. RA: Remote audible. Symbology: CV: Control panel-mounted visual. S: Shutdown of EPS indication. RA: Remote audible. X: Required. O: Optional. NA: Not applicable.</p>			

2.19.5 Time-Delay on Alarms

For startup of the engine-generator set, install time-delay devices bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. Submit the magnitude of monitored values which define alarm or action set points, and the tolerance (plus and/or minus) at which the devices activate the alarm or action for items contained within the alarm panels. The lube-oil time-delay device must return its alarm to normal status after the engine starts. The coolant time-delay device must return its alarm to normal status 5 minutes after the engine starts.

2.20 SYNCHRONIZING PANEL

Provide panel as specified in paragraph PANELS and provide controls, gauges, meters, and displays to include:

- a. Frequency meters, dial type, with a range of 90 to 110 percent of rated frequency. Do not use vibrating-reed type meters. One must monitor generator output frequency ("Generator Frequency Meter") and the other must monitor the frequency of the parallel source ("Bus Frequency Meter").
- b. Voltmeters, ac, dial type, 3-phase, with 4-position selector switch for the generator output ("Generator Volt Meter") and for the parallel power source ("Bus volt meter").
- c. Automatic synchronizer.
- d. Manual synchronizing controls.
- e. Indicating lights for supplementary indication of synchronization.
- f. Synchroscope.
- g. Wattmeter, indicating.

2.21 PANELS

Each panel must be of the type and kind necessary to provide specified functions. Mount panels on the engine-generator set base by vibration/shock absorbing type mountings. Mount instruments flush or semiflush. Provide convenient access to the back of panels to facilitate maintenance. Calibrate instruments using recognized industry calibration standards. Provide a panel identification plate identifying the panel function. Provide a plate identifying the device and its function for each instrument and device on the panel. Provide switch plates identifying the switch-position function.

2.21.1 Enclosures

Design enclosures for the application and environment, conforming to NEMA ICS 6. Locking mechanisms must be keyed alike.

Provide for each engine-generator set and fabricate from zinc coated or phosphatized and shop primed 16 gage minimum sheet steel in accordance with the manufacturer's standard design. Provide a complete, weatherproof enclosure for the engine, generator, and auxiliary systems and equipment. Support exhaust piping and silencer so that the turbocharger is not subjected to exhaust system weight or lateral forces generated in connecting piping that exceed the engine manufacturer's maximum allowed forces and moments. The housing must have sufficient louvered openings to allow entrance of outside air for engine and generator cooling at full load. Design louvered openings to exclude driving rain and snow. Provide properly arranged and sized, hinged panels in the enclosure to allow convenient access to the engine, generator, and control equipment for maintenance and operational procedures. Provide hinged panels with spring type latches which must hold the panels closed securely and will not allow them to vibrate. Brace the housing internally to prevent excessive vibration when the set is in operation

2.21.2 Analog

Provide analog electrical indicating instruments in accordance with UL 1437 with semi-flush mounting. Switchboard, switchgear, and control-room panel-mounted instruments must have 250 degree scales with an accuracy of not less than 99 percent. Unit-mounted instruments must be the manufacturer's standard with an accuracy of not less than 98 percent. The instrument's operating temperature range must be minus 4 to plus 158 degrees F. Distorted generator output voltage waveform of a crest factor less than 5 must not affect metering accuracy for phase voltages, hertz and amps.

2.21.3 Electronic

Electronic indicating instruments must be true RMS indicating instruments, 100 percent solid state, state-of-the-art, microprocessor controlled to provide specified functions. Provide control, logic, and function devices that are compatible as a system, sealed, dust and water tight, and that utilize modular components with metal housings and digital instrumentation. Provide an interface module to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy less than 98 percent for unit mounted devices and 99 percent for control room, panel mounted devices, throughout a temperature range of minus 4 to 158 degrees F is not acceptable. Provide LED or back lit LCD data display. Additionally, the

display must provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height must be 0.5 inch.

2.21.4 Parameter Display

Provide indication or readouts of the tachometer, lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and safety system parameters. Specify a momentary switch for other panels.

2.22 SURGE PROTECTION

Electrical and electronic components must be protected from, or designed to withstand the effects of surges from switching and lightning.

2.23 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Provide fully automatic operation for the following operations: engine-generator set starting and load transfer upon loss of normal source; retransfer upon restoration of the normal source; sequential starting; paralleling, and load-sharing for multiple engine-generator sets; and stopping of each engine-generator set after cool-down. Devices must automatically reset after termination of their function.

2.23.1 Automatic Transfer Switch

Provide automatic transfer switches in accordance with Section 26 36 23 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.24 MANUAL ENGINE-GENERATOR-SET SYSTEM OPERATION

Provide complete facilities for manual starting and testing of each set without load, loading and unloading of each set, and synchronization of each set with an energized bus.

2.25 BASE

Provide a steel base. Design the base to rigidly support the engine-generator set, ensure permanent alignment of rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment is maintained during shipping and normal operation. The base must permit skidding in any direction during installation and must withstand and mitigate the affects of synchronous vibration of the engine and generator. Provide base with suitable holes for anchor bolts and jacking screws for leveling.

2.26 THERMAL INSULATION

Provide thermal insulation as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.27 PAINTING AND FINISHING

Clean, prime and paint the engine-generator set in accordance with the manufacturer's standard color and practice.

2.28 FACTORY INSPECTION AND TESTS

Submit six complete reproducible copies of the factory inspection result on the checklist format specified below. Perform the factory tests on

each engine-generator set. The component manufacturer's production line test is acceptable as noted. Run each engine-generator set for at least 1 hour at rated output capacity prior to inspections. Complete inspections and make all necessary repairs prior to testing. Use engine generator controls and protective devices that are provided by the generator set manufacturer as part of the standard package for factory tests. When controls and switchgear are not provided as part of the generator set manufacturer's standard package, the actual controls and protective devices provided for the project are not required to be used during the factory test. The Contracting Officer may provide one or more representatives to witness inspections and tests.

2.28.1 Factory Inspection

Perform inspections prior to beginning and after completion of testing of the assembled engine-generator set. Look for leaks, looseness, defects in components, proper assembly, etc. and note any item found to be in need of correction as a necessary repair. Use the following checklist for the inspection:

INSPECTION ITEM	GOOD	BAD	NOTES
Drive belts			
Governor and adjustments			
Engine timing mark			
Starting motor			
Starting aids			
Coolant type and concentration			
Radiator drains			
Block coolant drains			
Coolant fill level			
All coolant line connections			
All coolant hoses			
Combustion air filter			
Combustion air silencer			
Lube oil type			
Lube oil sump drain			
Lube-oil filter			

INSPECTION ITEM	GOOD	BAD	NOTES
Lube-oil-level indicator			
Lube-oil-fill level			
All lube-oil line connections			
All lube-oil lines			
Fuel type and amount			
All fuel-line connections			
All fuel lines			
Fuel filter			
Coupling and shaft alignment			
Voltage regulators			
Battery-charger connections			
All wiring connections			
Instrumentation			
Hazards to personnel			
Base			
Nameplates			
Paint			
Exhaust-heat recovery unit			
Switchboard			
Switchgear			

2.28.2 Factory Tests

Submit a letter giving notice of the proposed dates of factory inspections and tests at least 14 days prior to beginning tests, including:

- a. A detailed description of the manufacturer's procedures for factory tests at least 14 days prior to beginning tests.
- b. Six copies of the Factory Test data described below in 8-1/2 by 11 inch binders having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each test. Separate sections by heavy plastic dividers with tabs. Provide full size (8-1/2 by 11 inch minimum) data plots showing grid lines, with

full resolution.

- (1) A detailed description of the procedures for factory tests.
- (2) A list of equipment used, with calibration certifications.
- (3) A copy of measurements taken, with required plots and graphs.
- (4) The date of testing.
- (5) A list of the parameters verified.
- (6) The condition specified for the parameter.
- (7) The test results, signed and dated.
- (8) A description of adjustments made.

On engine-generator set tests where the engine and generator are required to be connected and operated together, the load power factor must be the power factor specified in the engine generator set parameter schedule. Perform electrical measurements in accordance with IEEE 120. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulation must be in accordance with IEEE 1. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Tests specifically for the generator may be performed utilizing any prime mover.

- a. Insulation Resistance for Stator and Exciter Test, IEEE 115 and IEEE 43, to the performance criteria in NEMA MG 1, Part 22. Generator manufacturer's production line test is acceptable.
- b. High Potential Test, in accordance with IEEE 115 and NEMA MG 1, test voltage in accordance with NEMA MG 1. Generator manufacturer's production line test is acceptable.
- c. Winding Resistance Test, Stator and Exciter, in accordance with IEEE 115. Generator manufacturer's production line test is acceptable.
- d. Phase Balance Voltage Test, to the performance criteria specified in paragraph GENERATOR. This test can be performed with any prime mover. Generator manufacturer's production line test results are acceptable.
 - (1) Start and operate the generator at no load.
 - (2) Adjust a regulated phase voltage (line-to-neutral) to rated voltage.
 - (3) Read and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.
 - (4) Apply 75 percent rated load and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.
 - (5) Apply rated load and record the generator frequency,

line-to-neutral voltages, and the line-to-line voltages.

- (6) Calculate average line-neutral voltage and percent deviation of individual line-neutral voltages from average for each load condition.
- e. Current Balance on Stator Winding Test, by measuring the current on each phase of the winding with the generator operating at 100 percent of Rated Output Capacity, with the load impedance equal for each of the three phases: to the performance criteria specified in paragraph GENERATOR.
- f. Voltage Waveform Deviation and Distortion Test in accordance with IEEE 115 to the performance criteria specified in paragraph GENERATOR. Use high-speed recording instruments capable of recording voltage waveform deviation and all distortion, including harmonic distortion. Include appropriate scales to provide a means to measure and interpret results.
- g. Voltage and Frequency Droop Test. Verify that the output voltage and frequency are within the specified parameters as follows:
 - (1) With the generator operating at no load, adjust voltage and frequency to rated voltage and frequency. Record the generator output frequency and line-line and line-neutral voltages.
 - (2) Increase load to Rated Output Capacity. Record the generator output frequency and line-line and line-neutral voltages.
 - (3) Calculate the percent droop for voltage and frequency with the following equations:

$$\text{Voltage droop percent} = \frac{(\text{No-Load Volts}) - (\text{Rated Capacity Volts})}{(\text{Service-Load Volts})} \times 100$$

$$\text{Frequency droop percent} = \frac{(\text{No-Load Hertz}) - (\text{Rated Capacity Hertz})}{(\text{Service-Load Hertz})} \times 100$$

- (4) Repeat steps 1 through 3 two additional times without making any adjustments.
- h. Frequency and Voltage Stability and Transient Response. Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results in tabular form and with high resolution, high speed strip chart recorders or comparable digital recorders, as approved by the Contracting Officer. Include the following tabular data:
 - (1) Ambient temperature (at 15 minute intervals).
 - (2) Generator output current (before and after load changes).
 - (3) Generator output voltage (before and after load changes).

- (4) Frequency (before and after load changes).
- (5) Generator output power (before and after load changes).
- (6) Graphic representations must include the actual instrument trace of voltage and frequency showing: charts marked at start of test; observed steady-state band; mean of observed band; momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change. Generator terminal voltage and frequency transient recovery time for each step load increase and decrease.
 - (a) Perform and record engine manufacturer's recommended pre-starting checks and inspections.
 - (b) Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.
 - (c) With the unit at no load, apply the Maximum Step Load Increase.
 - (d) Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.
 - (e) Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100 percent of Service Load.
 - (f) Apply the Maximum Step Load Increase.
 - (g) Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.
 - (h) Repeat steps (c) through (g).
- j. Test Voltage Unbalance with Unbalanced Load (Line-to-Neutral) to the performance criteria specified in paragraph GENERATOR. Submit manufacturer's standard certification that prototype tests were performed for the generator model proposed. This test may be performed using any prime mover.
 - (1) Start and operate the generator set at rated voltage, no load, rated frequency, and under control of the voltage regulator. Read and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.
 - (2) Apply the specified load between terminals L_1-L_2 , L_2-L_0 , and L_3-L_0 in turn. Record all instrument readings at each line-neutral condition.
 - (3) Express the greatest difference between any two of the line-to-line voltages and any two of the line-to-neutral voltages

as a percent of rated voltage.

- (4) Compare the largest differences expressed in percent with the maximum allowable difference specified.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the job, perform a Site Visit to verify the information shown on the drawings, before performing any work. Submit a letter stating the date the site was visited and listing discrepancies found. Notify the Contracting Officer in writing of any discrepancies.

3.2 GENERAL INSTALLATION

Provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Submit a copy of the manufacturer's installation procedures and a detailed description of the manufacturer's recommended break-in procedure. Install pipe, duct, conduit, and ancillary equipment to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.3 ELECTRICAL INSTALLATION

Perform electrical installation in compliance with NFPA 70, IEEE C2, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. For vibration isolation, provide flexible fittings for conduit, cable trays, and raceways attached to engine-generator sets; provide flexible stranded conductor for metallic conductor cables installed on the engine generator set and from the engine generator set to equipment not mounted on the engine generator set; and provide crimp-type terminals or lugs for terminations of conductors on the engine generator set.

3.4 FIELD PAINTING

Perform field painting as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5 ONSITE INSPECTION AND TESTS

Perform and report on factory tests and inspections prior to shipment. Provide certified copies of manufacturer's test data and results. Test procedures must conform to NFPA 110 and ANSI standards, and to ISO requirements on testing, as appropriate and applicable. The manufacturer performing the tests must provide equipment, labor, and consumables necessary for tests and measuring and indicating devices must be certified to be within calibration. Tests must indicate satisfactory operation and attainment of specified performance. If satisfactory, equipment tested will be given a tentative approval. Equipment must not be shipped before approval of the factory test reports for the following tests.

Submit a letter giving notice of the proposed dates of onsite inspections and tests at least 14 days prior to beginning tests.

- a. Submit a detailed description of the Contractor's procedures for onsite tests including the test plan and a listing of equipment necessary to perform the tests at least 14 days prior to beginning

tests.

- b. Submit six copies of the onsite test data described below in 8-1/2 by 11 inch binders having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each test. Separate sections by heavy plastic dividers with tabs. Provide full size (8-1/2 by 11 inch minimum) data plots showing grid lines, with full resolution.

- (1) A detailed description of the procedures for onsite tests.
- (2) A list of equipment used, with calibration certifications.
- (3) A copy of measurements taken, with required plots and graphs.
- (4) The date of testing.
- (5) A list of the parameters verified.
- (6) The condition specified for the parameter.
- (7) The test results, signed and dated.
- (8) A description of adjustments made.

3.5.1 Test Conditions

3.5.1.1 Data

Make and record measurements of all parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, make adjustments, replacements, or repairs and repeat the step until satisfactory results are obtained. Unless otherwise indicated, record data in 15 minute intervals during engine-generator set operation and include: readings of all engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set. Perform electrical measurements in accordance with IEEE 120. Definitions of terms are in accordance with IEEE 100. Provide temperature limits in the rating of electrical equipment and for the evaluation of electrical insulations in accordance with IEEE 1.

3.5.1.2 Power Factor

Submit the generator capability curve showing generator kVA output capability (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0. For all engine-generator set operating tests the load power factor must be the power factor specified in the engine-generator set parameter schedule.

3.5.1.3 Contractor Supplied Items

Provide equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.5.1.4 Instruments

Verify readings of panel gauges, meters, displays, and instruments provided as permanent equipment during test runs, using test instruments of greater precision and accuracy. Test instrument accuracy must be within the following: current plus or minus 1.5 percent, voltage plus or minus 1.5 percent, real power plus or minus 1.5 percent, reactive power plus or minus 1.5 percent, power factor plus or minus 3 percent, frequency plus or minus 0.5 percent. Calibrate test instruments by a recognized standards laboratory within 30 days prior to testing.

3.5.1.5 Sequence

Provide the sequence of testing as specified in the approved testing plan unless variance is authorized by the Contracting Officer. Perform field testing in the presence of the Contracting Officer. Schedule and sequence tests in order to optimize run-time periods; however, follow the general order of testing: Construction Tests; Inspections; Pre-operational Tests; Safety Run Tests; Performance Tests; and Final Inspection.

3.5.2 Construction Tests

Perform individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer prior to connection to the engine-generator set.

3.5.2.1 Piping Test

- a. Flush lube-oil and fuel-oil piping with the same type of fluid intended to flow through the piping, until the outflowing fluid has no obvious sediment or emulsion.
- b. Test fuel piping which is external to the engine-generator set in accordance with NFPA 30. Pressure all remaining piping which is external to the engine-generator set with air pressure at 150 percent of the maximum anticipated working pressure, but not less than 150 psi, for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, perform the test before the insulation is applied.

3.5.2.2 Electrical Equipment Tests

- a. Perform low-voltage cable insulation integrity tests for cables connecting the generator breaker to the automatic transfer switch. Test low-voltage cable, complete with splices, for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. Apply a test voltage of 500 volts dc for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. Provide the minimum value of insulation as follows:

(1) R in meg-ohms = (rated voltage in kV plus 1) x 304.8/(length of cable in meters)

(2) R in meg-ohms = (rated voltage in kV plus 1) x 1000/(length of cable in feet)

(3) Each cable failing this test must be repaired or replaced. The repair cable must be retested until failures have been eliminated.

b. Ground-Resistance Tests. Measure the resistance of each grounding electrode the ground ring using the fall-of-potential method defined in IEEE 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. Take measurements in normally dry weather, not less than 48 hours after rainfall. Provide site diagram indicating location of test probes with associated distances, and provide a plot of resistance vs. distance. The combined resistance of separate systems may be used to meet the requirements resistance, but the specified number of electrodes must still be provided as follows:

(1) Single rod electrode - 25 ohms.

(2) Multiple rod electrodes - 10 ohms.

c. Examine and test circuit breakers and switchgear in accordance with the manufacturer's published instructions for functional testing.

3.5.3 Inspections

Perform the following inspections jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Submit a letter certifying that all facilities are complete and functional; that each system is fully functional; and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use. Perform checks applicable to the installation. Document and submit the results of those which are physical inspections (I) in accordance with paragraph SUBMITTALS. Present manufacturer's data for the inspections designated (D) at the time of inspection. Verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Provide manufacturer's statements to certify provision of features which cannot be verified visually.

Drive belts	I
Governor type and features	I
Engine timing mark	I
Starting motor	I
Starting aids	I
Coolant type and concentration	D
Radiator drains	I
Block coolant drains	I

Coolant fill level	I
Coolant line connections	I
Coolant hoses	I
Combustion air filter	I
Intake air silencer	I
Lube oil type	D
Lube oil sump drain	I
Lube-oil filter	I
Lube-oil level indicator	I
Lube-oil fill level	I
Lube-oil line connections	I
Lube-oil lines	I
Fuel type	D
Fuel level	I
Fuel-line connections	I
Fuel lines	I
Fuel filter	I
Access for maintenance	I
Voltage regulator	I
Battery-charger connections	I
Wiring and terminations	I
Instrumentation	I
Hazards to personnel	I
Base	I
Nameplates	I
Paint	I
Exhaust-heat system	I

Exhaust muffler	I
Switchboard	I
Switchgear	I
Access provided to controls	I
Enclosure is weather resistant	I
Engine and generator mounting bolts (application)	I

3.5.4 Engine Tests

Perform customary commercial factory tests in accordance with ISO 3046 on each engine and associated engine protective device, including, but not limited to the following:

- a. Perform dynamometer test at rated power. Record horsepower at rated speed and nominal characteristics such as lubricating oil pressure, jacket water temperature, and ambient temperature.
- b. Test and record the values that the low oil pressure alarm and protective shutdown devices actuate prior to assembly on the engine.
- c. Test and record values that the high jacket water temperature alarm and protective shutdown devices actuate prior to assembly on the engine.

3.5.5 Generator Tests

Tests must be performed on the complete factory assembled generator prior to shipment. Conduct tests in accordance with IEEE 115, and NEMA MG 1.

3.5.5.1 Routine Tests

Perform the following routine tests on the generators and their exciters:

- a. Resistance of armature and field windings.
- b. Mechanical balance.
- c. Phases sequence.
- d. Open circuit saturation curve and phase (voltage) balance test.
- e. Insulation resistance of armature and field windings.
- f. High potential test.

3.5.5.2 Design Tests

Submit the following design tests made on prototype machines that are physically and electrically identical to the generators specified.

- a. Temperature rise test

b. Short circuit saturation curve and current balance test

3.5.6 Assembled Engine-Generator Set Tests

Submit the following tests made on prototype machines that are physically and electrically identical to the engine-generator set specified.

3.5.6.1 Initial Stabilization Readings

Operate the engine-generator set and allow the set to stabilize at rated kW at rated power factor, rated voltage, and rated frequency. During this period record instrument readings for output power (kW), terminal voltage, line current, power factor, frequency (rpm) generator (exciter) field voltage and current, lubricating oil pressure, jacket water temperature, and ambient temperature at minimum intervals of 15 minutes. Adjust the load, voltage, and frequency to maintain rated load at rated voltage and frequency. Adjustments to load, voltage, or frequency controls must be recorded on the data sheet at the time of adjustment. Stabilization must be considered to have occurred when four consecutive voltage and current recorded readings of the generator (or exciter) field either remain unchanged or have only minor variations about an equilibrium condition with no evident continued increase or decrease in value after the last adjustment to the load, voltage, or frequency has been made.

3.5.6.2 Regulator Range Test

Remove load and record instrument readings (after transients have subsided). Adjust voltage to the maximum attainable value or to a value just prior to actuation of the overvoltage protection device. Apply rated load and adjust voltage to the minimum attainable value or a value just prior to activation of the under-voltage protection device. The data sheets must indicate the voltage regulation as a percent of rated voltage and the maximum and minimum voltages attainable. Voltage regulation must be defined as follows:

$$\text{Percent Regulation} = \frac{((\text{No-Load Voltage}) - (\text{Rated-Load Voltage})) \times 100}{(\text{Rated-Load Voltage})}$$

3.5.6.3 Frequency Range Test

Adjust the engine-generator set frequency for the maximum attainable frequency at rated load. Record instrument readings. Adjust the engine-generator set frequency for the specified minimum attainable frequency at rated load. Record instrument readings. Reduce the load to zero and adjust the engine-generator set frequency for the maximum attainable frequency. Record instrument readings. Adjust the engine-generator set frequency for the minimum attainable frequency. Record instrument readings. The data sheet must show the maximum and minimum frequencies attained at rated load, and at no load.

3.5.6.4 Transient Response Test

Drop the load to no load and re-apply rated load three times to ensure that the no load and rated load voltage and frequency values are repeatable and that the frequency and voltage regulation is within the limits specified. Record generator terminal voltage and frequency using a high speed strip chart recorder. The data sheet must show the following

results:

a. Frequency

- (1) Stability bandwidth or deviation in percent of rated frequency.
- (2) Recovery time.
- (3) Overshoot and undershoot.

b. Voltage

- (1) Stability bandwidth or deviation in percent of rated voltage.
- (2) Recovery time.
- (3) Overshoot and undershoot.

3.5.7 Pre-operational Tests

3.5.7.1 Protective Relays

Visually and mechanically inspect, adjust, test, and calibrate protective relays in accordance with the manufacturer's published instructions. Include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Implement relay settings in accordance with the installation coordination study. Manually or electrically operate relay contacts to verify that the proper breakers and alarms initiate. Field test relaying current transformers in accordance with IEEE C57.13.1.

3.5.7.2 Insulation Test

Test generator and exciter circuits insulation resistance in accordance with IEEE 43. Take stator readings including generator leads to automatic transfer switch at the circuit breaker. Record results of insulation resistance tests. Readings must be within limits specified by the manufacturer. Verify mechanical operation, insulation resistance, protective relay calibration and operation, and wiring continuity of automatic transfer switch assembly. Do not damage generator components during test.

3.5.7.3 Engine-Generator Connection Coupling Test

When the generator provided is a two-bearing machine, inspect and check the engine-generator connection coupling by dial indicator to prove that no misalignment has occurred. Use the dial indicator to measure variation in radial positioning and axial clearance between the coupling halves. Take readings at four points, spaced 90 degrees apart. Align solid couplings and pin-type flexible couplings within a total indicator reading of 0.0005 to 0.001 inch for both parallel and angular misalignment. For gear-type or grid-type couplings, 0.002 inch will be acceptable.

3.5.8 Safety Run Test

For the following tests, repeat the associated safety tests if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries.

- a. Perform and record engine manufacturer's recommended prestarting checks and inspections.
- b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.
- c. Activate the manual emergency stop switch and verify that the engine stops.
- d. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. Operate the engine-generator set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If either temperature reading exceeds the value required for an alarm condition, activate the manual emergency stop switch.
- e. Operate the engine generator-set for at least 2 hours at 75 percent of Service Load.
- f. Verify proper operation and set-points of gauges and instruments.
- g. Verify proper operation of ancillary equipment.
- h. Manually adjust the governor to increase engine speed past the over-speed limit. Record the RPM at which the engine shuts down.
- i. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of Service Load.
- j. Manually adjust the governor to increase engine speed to within 2 percent of the over-speed trip speed previously determined and operate at that point for 5 minutes. Manually adjust the governor to the rated frequency.
- k. Manually fill the day tank to a level above the overfill limit. Record the level at which the overfill alarm sounds. Verify shutdown of the fuel transfer pump. Drain the day tank down below the overfill limit.
- l. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine.
- m. Attach a manifold to the engine oil system (at the oil pressure sensor port) that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. Move the engine's oil pressure sensor from the engine to the manifold. Open the manifold shutoff valve and close the bleed valve.
- n. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of Service Load.
- o. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the

pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.

- p. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100 percent of Service Load. Record the maximum sound level in each frequency band at a distance of 75 feet from the end of the exhaust and air intake piping directly along the path of intake and discharge for horizontal piping; or at a radius of 75 feet from the engine at 45 degrees apart in all directions for vertical piping. If a sound limiting enclosure is provided, modify or replace the enclosure, the muffler, and intake silencer must be modified or replaced as required to meet the sound requirements contained within this specification. If a sound limiting enclosure is not provided, the muffler and air intake silencer as required to meet the sound limitations of this specification. If the sound limitations can not be obtained by modifying or replacing the muffler and air intake silencer, notify the Contracting Officers Representative and provide a recommendation for meeting the sound limitations.
- q. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it above low level alarm limits.

3.5.9 Performance Tests

In the following tests, where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. For the following tests, repeat the associated tests if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries.

3.5.9.1 Voltage and Frequency Droop Test

For the following steps, verify that the output voltage and frequency return to and stabilize within the specified bandwidth values following each load change. Record the generator output frequency and line-line and line-neutral voltages following each load change.

- a. With the generator operating at no load, adjust voltage and frequency to rated voltage and frequency.
- b. Increase load to 100 percent of Rated Output Capacity. Record the generator output frequency and line-line and line-neutral voltages.
- c. Calculate the percent droop for voltage and frequency with the following equations.

$$\text{Voltage droop percent} = \frac{\text{No-load volts} - \text{rated output capacity volts}}{\text{Rated output capacity volts}} \times 100$$

$$\text{Frequency droop percent} = \frac{\text{No load hertz} - \text{rated output capacity hertz}}{\text{Rated output capacity volts}} \times 100$$

- d. Repeat steps a. through c. two additional times without making any adjustments.

3.5.9.2 Voltage Regulator Range Test

- a. While operating at no load, verify that the voltage regulator adjusts from 90 to 110 percent of rated voltage.
- b. Increase load to 100 percent of Rated Output Capacity. Verify that the voltage regulator adjusts from 90 to 110 percent of rated voltage.

3.5.9.3 Governor Adjustment Range Test

- a. While operating at no load, verify that the governor adjusts from 90 to 110 percent of rated frequency.
- b. Increase load to 100 percent of Rated Output Capacity. Verify that the governor adjusts from 90 to 110 percent of rated frequency.

3.5.9.4 Frequency and Voltage Stability and Transient Response

Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results in tabular form and with high resolution, high speed strip chart recorders or comparable digital recorders, as approved by the Contracting Officer. Include the following tabular data:

- (1) Ambient temperature (at 15 minute intervals).
- (2) Generator output current (before and after load changes).
- (3) Generator output voltage (before and after load changes).
- (4) Frequency (before and after load changes).
- (5) Generator output power (before and after load changes).
- (6) Include the actual instrument trace of voltage and frequency in graphic representations showing:

Charts marked at start of test; observed steady-state band; mean of observed band; momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change. Generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

- a. Perform and record engine manufacturer's recommended prestarting checks and inspections.
- b. Start the engine, make and record engine manufacturer's after-starting

checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

- c. With the unit at no load, apply the Maximum Step Load Increase.
- d. Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.
- e. Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100 percent of Service Load.
- f. Apply the Maximum Step Load Increase.
- g. Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.
- h. Repeat steps c. through g.

3.5.10 Automatic Operation Tests for Stand-Alone Operation

Test the automatic loading system to demonstrate automatic starting, of each engine-generator set. Utilize the actual loads to be served for this test, and the loading sequence is the indicated sequence. Perform this test for a minimum of two successive, successful tests. Include the following data:

- (1) Ambient temperature (at 15 minute intervals).
- (2) Generator output current (before and after load changes).
- (3) Generator output voltage (before and after load changes).
- (4) Generator output frequency (before and after load changes).
- a. Initiate loss of the primary power source and verify automatic sequence of operation.
- b. Restore the primary power source and verify sequence of operation.
- c. Verify resetting of controls to normal.

3.6 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems must have a resistance to solid earth ground not exceeding 5 ohms.

3.6.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.6.2 Engine-Generator Set Grounding

Provide separate copper grounding conductors and connect them to the ground system as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the

provision of the contract covering "Changes" must apply.

3.6.3 Connections

Make joints in grounding conductors by exothermic weld or compression connector. Exothermic welds and compression connectors must be installed as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION paragraph regarding GROUNDING.

3.6.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.7 START-UP ENGINEER

Provide the services of a qualified factory trained start-up engineer, regularly employed by the engine-generator set manufacturer. The start-up services must include conducting preliminary operations and functional acceptance tests. The start-up engineer must be present at the engine generator set installation-site, full-time, while preliminary operations and functional acceptance tests are being conducted.

3.8 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the engine-generator set and auxiliary equipment.

3.8.1 Performance of Acceptance Checks and Tests

The acceptance checks and tests must be accomplished by the testing organization as described in Section 26 08 00 APPARATUS INSPECTION AND TESTING.

3.8.2 Generator Sets

Complete as specified in the paragraph ACCEPTANCE CHECKS AND TESTS.

3.8.2.1 Automatic Transfer Switches

Complete acceptance checks and tests as specified in Section 26 36 23 AUTOMATIC TRANSFER SWITCHES AND BY-PASS/ISOLATION SWITCH.

3.8.3 Preliminary Operations

The start-up engineer must conduct manufacturer recommended start-up procedures and tests to verify that the engine-generator set and auxiliary equipment are ready for functional acceptance tests. Give the Contracting Officer 15 days' advance notice that preliminary operations will be conducted. After preliminary operation has been successfully conducted, the start-up engineer will notify the Contracting Officer in writing stating the engine-generator set and auxiliary equipment are ready for functional acceptance tests.

3.8.4 Preliminary Assembled Operation and Maintenance Manuals

Preliminary assembled operation and maintenance manuals must have been submitted to and approved by the Contracting Officer. Manuals must be prepared as specified in the paragraph ASSEMBLED OPERATION AND MAINTENANCE

MANUALS.

3.8.5 Functional Acceptance Test Procedure

Test procedure must be prepared by the start-up engineer specifically for the engine-generator set and auxiliary equipment. The test agenda must cover the requirements specified in the paragraph FUNCTIONAL ACCEPTANCE TESTS. The test procedure must indicate in detail how tests are to be conducted. A statement of the tests that are to be performed without indicating how the tests are to be performed is not acceptable. Indicate what work is planned on each workday and identify the calendar dates of the planned workdays. Specify what additional technical support personnel is needed such as factory representatives for major equipment. Specify on which testing workday each technical support personnel is needed. Data recording forms to be used to document test results are to be submitted with the proposed test procedure. A list of test equipment and instruments must also be included in the test procedure.

3.8.6 Test Equipment

Test equipment and instruments must be on hand prior to scheduling field tests or, subject to Contracting Officer approval, evidence must be provided to show that arrangements have been made to have the necessary equipment and instruments on-site prior to field testing.

3.9 FIELD QUALITY CONTROL

Give Contracting Officer 30 days' notice of dates and times scheduled for tests which require the presence of the Contracting Officer. The Contracting Officer will coordinate with the using activity and schedule a time that will eliminate or minimize interruptions and interference with the activity operations. The Contractor must be responsible for costs associated with conducting tests outside of normal working hours and with incorporating special arrangements and procedures, including temporary power conditions. The Contractor must provide labor, equipment, fuel, test load, and consumables required for the specified tests. The test load must be a cataloged product. Calibration of measuring devices and indicating devices must be certified. Refer to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, for requirements for a cataloged product. Perform the following field tests.

3.9.1 Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.9.1.1 Circuit Breakers - Low Voltage Insulated Case/Molded Case

a. Visual and Mechanical Inspection

- (1) Compare nameplate data with specifications and approved shop drawings.
- (2) Inspect circuit breaker for correct mounting.
- (3) Operate circuit breaker to ensure smooth operation.
- (4) Inspect case for cracks or other defects.

(5) Verify tightness of accessible bolted connections and cable connections by calibrated torque-wrench method. Thermo-graphic survey is not required.

(6) Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

(1) Perform contact-resistance tests.

(2) Perform insulation-resistance tests.

(3) Adjust breaker(s) for final settings in accordance with engine-generator set manufacturer's requirements.

3.9.1.2 Current Transformers

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary and secondary circuit.

(5) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermo-graphic survey is not required.

(6) Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

(1) Perform insulation-resistance tests.

(2) Perform polarity tests.

(3) Perform ratio-verification tests.

3.9.1.3 Metering and Instrumentation

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical Tests

(1) Determine accuracy of meters at 25, 50, 75, and 100 percent of

full scale.

- (2) Calibrate watt-hour meters according to manufacturer's published data.
- (3) Verify all instrument multipliers.
- (4) Electrically confirm that current transformer secondary circuits are intact.

3.9.1.4 Battery Systems

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermo-graphic survey is not required.
- (4) Measure electrolyte specific gravity and temperature and visually check fill level.
- (5) Verify adequacy of battery support racks, mounting, anchorage, and clearances.

b. Electrical Tests

- (1) Set charger float and equalizing voltage levels.
- (2) Verify all charger functions and alarms.
- (3) Measure each cell voltage and total battery voltage with charger energized and in float mode of operation.
- (4) Perform a capacity load test.

3.9.1.5 Engine-Generator Set

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Inspect for correct anchorage and grounding.

b. Electrical and Mechanical Tests

- (1) Perform an insulation-resistance test on generator winding with respect to ground. Calculate polarization index.
- (2) Perform phase rotation test to determine compatibility with load requirements.

3.9.1.6 Grounding System

a. Visual and Mechanical Inspection

- (1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

- (1) Perform ground-impedance measurements utilizing the fall-of-potential method defined in IEEE 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. Take measurements in normally dry weather, not less than 48 hours after rainfall. Provide site diagram indicating location of test probes with associated distances, and provide a plot of resistance vs. distance.

3.9.2 Functional Acceptance Tests

The tests must be performed by the start-up engineer. Upon successful test completion, the start-up engineer must provide the Contracting Officer with a written test report within 15 calendar days showing the tests performed and the results of each test. The report must include the completed approved test data forms and certification from the start-up engineer that the test results fall within the manufacturer's recommended limits and meet the specified requirements performance. The report must be dated and signed by the start-up engineer, and submitted for approval by the Contracting Officer. The Contracting Officer will witness final acceptance tests. Testing must include, but not be limited to, the following:

- a. Verify proper functioning of each engine protective shutdown device and pre-shutdown alarm device. Testing of the devices must be accomplished by simulating device actuation and observing proper alarm and engine shutdown operation.
- b. Verify proper functioning of the engine over-speed trip device. Testing of the over-speed trip device must be accomplished by raising the speed of the engine-generator set until an over-speed trip is experienced.
- c. Verify proper functioning of the crank cycle/terminate relay. Testing of the relay must be accomplished by engaging the starter motor with the engine being prevented from running. Observe the complete crank/rest cycle as described in the paragraph STARTING SYSTEM.
- d. Verify proper functioning of the following automatic and manual operations. Testing must include, but not be limited to, the following:
 - (1) Loss of Utility: Initiate a normal power failure with connected test load of rated kW at 1.0 power factor. Record time delay on start, cranking time until engine starts and runs, time to come up to operating speed, voltage and frequency overshoot, and time to achieve steady state conditions with all switches transferred to emergency position.
 - (2) Return of Utility: Return normal power and record time delay on retransfer for each automatic transfer switch, and time delay on

engine cool-down and shutdown.

(3) Manual starting.

(4) Emergency stop.

- e. Operate the engine-generator set at rated current (amperes) until the jacket water temperature stabilizes. Stabilization will be considered to have occurred when three consecutive temperature readings remain unchanged. Continue to operate the generator set for an additional 2 hours. Record instrument readings for terminal voltage, line current, frequency (Hz), engine speed rpm, lubricating oil pressure, jacket water temperature, and ambient temperature at 5 minute intervals for first 15 minutes and at 15 minute intervals thereafter.

3.10 DEMONSTRATION

Upon completion of the work and at a time approved by the Contracting Officer, the Contractor must provide instructions by a qualified instructor to the Government personnel in the proper operation and maintenance of the equipment. Government personnel must receive training comparable to the equipment manufacturer's factory training. The duration of instruction must be for not less than one 8 hour working day for instruction of operating personnel and not less than one 8 hour working day for instruction of maintenance personnel.

3.10.1 Instructor's Qualification Resume

Instructors must be regular employees of the engine-generator set manufacturer. The instruction personnel provided to satisfy the requirements above must be factory certified by the related equipment manufacturer to provide instruction services. Submit the name and qualification resume of instructor to the Contracting Officer for approval.

3.10.2 Training Plan

Submit training plan 30 calendar days prior to training sessions. Training plan must include scheduling, content, outline, and training material (handouts). Content must include, but not be limited to, the following:

3.10.2.1 Operating Personnel Training

This instruction includes operating the engine-generator set, auxiliary equipment including automatic transfer switches in all modes, and the use of all functions and features specified.

3.10.2.2 Maintenance Personnel Training

Training must include mechanical, hydraulic, electrical, and electronic instructions for the engine-generator set and auxiliary equipment including automatic transfer switches.

- a. Mechanical Training: Must include at least the following:

- (1) A review of mechanical diagrams and drawings.

- (2) Component location and functions.

- (3) Troubleshooting procedures and techniques.
 - (4) Repair procedures.
 - (5) Assembly/disassembly procedures.
 - (6) Adjustments (how, when, and where).
 - (7) Preventive maintenance procedures.
 - (8) Review of flow diagram.
 - (9) Valve locations and function.
 - (10) Valve and hydraulic equipment adjustment and maintenance procedures.
 - (11) Hydraulic system maintenance and servicing.
 - (12) Lubrication points, type, and recommended procedures and frequency.
- b. Electrical and Electronic Maintenance Training: Must include at least the following:
- (1) A review of electrical and electronic systems including wiring diagrams and drawings.
 - (2) Troubleshooting procedures for the machine and control systems.
 - (3) Electrical and electronic equipment servicing and care.
 - (4) Use of diagnostics to locate the causes of malfunction.
 - (5) Procedures for adjustments (locating components, adjustments to be made, values to be measured, and equipment required for making adjustments).
 - (6) Maintenance and troubleshooting procedures for microprocessor or minicomputer where applicable.
 - (7) Circuit board repair procedures where applicable (with schematics provided).
 - (8) Use of diagnostic tapes.
 - (9) Recommended maintenance servicing and repair for motors, switches, relays, solenoids, and other auxiliary equipment and devices.

3.11 INSTALLATION

Installation must conform to the applicable requirements of IEEE C2, NFPA 30, NFPA 37, and NFPA 70.

3.12 FINAL TESTING AND INSPECTION

- a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

- b. Increase the load in steps no greater than the Maximum Step Load Increase to 100 percent of Service Load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.
- c. Remove load and shut down the engine-generator set after the recommended cool down period.
- d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Verify any corrective action for effectiveness by running the engine for 8 hours at Service Load, then re-examine the oil and filter.
- e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.
- f. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.
- g. Replace air, oil, and fuel filters with new filters.

3.13 MANUFACTURER'S FIELD SERVICE

The engine generator-set manufacturer must furnish a qualified representative to supervise the installation of the engine generator-set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.14 ACCEPTANCE

Submit drawings which accurately depict the as-built configuration of the installation, upon acceptance of the engine-generator set installation. Revise layout drawings to reflect the as-built conditions and submit them with the as-built drawings. Final acceptance of the engine-generator set will not be given until the Contractor has successfully completed all tests and all defects in installation material or operation have been corrected.

-- End of Section --

SECTION 26 33 53

STATIC UNINTERRUPTIBLE POWER SUPPLY (UPS)

05/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709 (2017) Standard Specification for
Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative
Dictionary of IEEE Standards Terms

IEEE 485 (2020) Recommended Practice for Sizing
Lead-Acid Batteries for Stationary
Applications

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

IEEE C62.41 (1991; R 1995) Recommended Practice on
Surge Voltages in Low-Voltage AC Power
Circuits

IEEE C62.41.1 (2002; R 2008) Guide on the Surges
Environment in Low-Voltage (1000 V and
Less) AC Power Circuits

IEEE C62.41.2 (2002) Recommended Practice on
Characterization of Surges in Low-Voltage
(1000 V and Less) AC Power Circuits

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2017; Errata 2017) Standard for
Acceptance Testing Specifications for
Electrical Power Equipment and Systems

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001 (2015) Quality Management Systems-
Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2018) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NEMA PE 1 (2012; R 2017) Uninterruptible Power

Systems (UPS) - Specification and
Performance Verification

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15 Radio Frequency Devices (47 CFR 15)

UNDERWRITERS LABORATORIES (UL)

UL 1778 (2014; Reprint Sep 2017) UL Standard for
Safety Uninterruptible Power Systems

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE 100.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

UPS Drawings; G

UPS Installation; G

SD-03 Product Data

UPS Module; G

Technical Requirements UPS System

SD-06 Test Reports

Work Plan

Factory Test Plan

Factory Test Report; G

SD-09 Manufacturer's Field Reports

Initial Inspection and Tests; G

Performance Tests; G

Performance Test Plan

Performance Test Report

SD-10 Operation and Maintenance Data

UPS Operation and Maintenance, Data Package 5; G

Submit operation and maintenance data in accordance with Section
01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

Installation

1.4 OPERATION AND MAINTENANCE MANUALS

1.4.1 Additions to UPS Operation and Maintenance Manuals

In addition to requirements of SD-10 Data Package 5, include the followings on the actual UPS system provided:

- a. An outline drawing, front, top, and side views.
- b. Prices for spare parts and supply list.
- c. Routine and field acceptance test reports.
- d. Date of Purchase.
- e. Corrective maintenance procedures.

1.5 QUALITY ASSURANCE

The manufacturer must have a documented quality assurance program including:

- a. Inspections of incoming parts, modular assemblies and final product.
- b. Final test procedure for the product including proof of performance specifications.
- c. The on-site test procedure includes an inspection of controls and indicators after installation of the equipment.
- d. ISO 9001 quality certification.

1.5.1 UPS Drawings

Drawings are to include the following: Detail drawings consisting of a complete list of equipment and materials, manufacturer's descriptive and technical literature, battery sizing calculations per IEEE 485, installation instructions, single-line diagrams, elevations, layout drawings, and details required to demonstrate that the system has been coordinated and will function properly as a unit.

- a. One-line diagram.
- b. Outline drawings including front elevation, section views, footprints, and overall dimensions.

- c. Manufacturer's descriptive and technical literature.
- d. Markings and NEMA nameplate data.
- e. Battery sizing calculations per IEEE 485.
- f. Wiring and control diagrams with terminals identified, and indicating prewired interconnections between items of equipment and interconnection between the items.
- g. Complete list of materials and equipment covering major components. Ensure the bill of material and the schematic have a direct correlation between items in order to easily identify the various components.
- h. Details required to demonstrate that the system has been coordinated and will function properly as a unit.

1.5.2 UPS Installation

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams are to identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings are to indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals include the nameplate data, size, and capacity. Submittals also include applicable federal, military, industry, and technical society publication references.

1.5.3 Work Plan

Submit schedules of dates for factory tests, installation, field tests, and operator training for the UPS system. Furnish a list of instrumentation equipment for factory and field test reports.

1.5.4 Factory Test Plan

Submit factory test plans and procedures at least 21 calendar days prior to the tests being conducted. Provide detailed description of test procedures, including test equipment and setups, to be used to ensure the UPS meets the performance specification and explain the test methods to be used. Provide test procedures that include the test required under the paragraph entitled "Factory Testing."

1.5.5 Factory Test Report

Submit a factory test report within 21 calendar days after completion of tests. Receive approval of test prior to shipping unit. Factory test reports are to be signed by an official authorized to certify on behalf of the UPS manufacturer of that the system meets specified requirements in accordance with the requirements set forth in paragraph entitled "Factory Testing". Provide test reports in booklet form tabulating factory tests and measurements performed, upon completion and testing of the installed system. Reports are to state the Contractor's name and address, the name of the project and location, and list the specific requirements which are being certified.

1.5.6 Performance Test Plan

Submit test plans and procedures at least 15 calendar days prior to the start of field tests. Provide detailed description and dates and times scheduled for performance of tests, and detailed description of test procedures, including test equipment (list make and model and provide functional description of the test instruments and accessories) and setups of the tests to be conducted to ensure the UPS meets the performance specification. Explain the test methods to be used. Provide test procedures that include the tests required under the paragraph entitled "Performance Tests."

1.5.7 Performance Test Report

Submit report of test results as specified by paragraph entitled "Performance Tests" within 15 calendar days after completion of tests. Field test reports are to be signed by an official authorized to certify on behalf of the UPS manufacturer that the system meets specified requirements in accordance with the requirements set forth in paragraph entitled "Performance Tests". Provide test reports in in booklet form tabulating factory tests and measurements performed, upon completion and testing of the installed system. Reports are to state the Contractor's name and address, the name of the project and location, and list the specific requirements which are being certified.

1.5.8 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.8.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.5.8.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate is to state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.9 Standard Products

Provide materials and equipment that are products of manufacturers

regularly engaged in the production of such products which are of equal material, design and workmanship and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.
- d. The service organization is to be, in the opinion of the Contracting Officer, reasonably convenient to the site.
- e. Provide new parts and materials comprising the UPS system from the current manufacture, of a high grade and free of defects and imperfections, and has not been in prior service except as required during aging and factory testing.

1.5.9.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.9.2 Material and Equipment Manufacturing Date

Products manufactured more than 6 months prior to date of delivery to site are not acceptable.

1.6 INSPECTION

Inspection before shipment is required. The manufacturer must notify the Government at least 2 weeks before shipping date so that an inspection can be made.

1.7 DELIVERY AND STORAGE

Protect equipment placed in storage from humidity and temperature variations, moisture, water intrusion, dirt, airborne corrosives, or other contaminants. In harsh environments where temperatures exceed non-operational parameters established within this specification, provide an environmentally controlled equipment storage facility to ensure temperature parameters are within equipment specification. Provide documentation of same to the Government when storage is implemented.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide continuous duty, three-phase, solid state, on-line double conversion reverse transfer static UPS(s). The UPS by means of solid state conversion techniques, must provide continuous regulated AC power to its output terminals, while operating from an input power source, cabinet

or rack-mounted direct current (DC) storage battery or other approved means. The performance of the UPS must not be degraded when operating without a system battery, provided the input AC source is within tolerance. Provide an UPS system that conforms to UL 1778 and consists of UPS module, battery system, battery protective device, system cabinet, static bypass transfer switch, controls and monitoring, system protective devices, means of isolating the UPS system from the critical load, and remote monitoring interfaces. Connect input ac power the normal source ac input of the UPS module. Connect battery to the dc input of the UPS module through the battery protective device. The following configuration is used:

a. Non-Redundant.

- (1) Single Module. On-line, single module UPS configuration capable of supplying power to the total load, with bypass availability.

2.2 MODES OF OPERATION

2.2.1 Normal

The UPS module rectifier/charger must convert the incoming ac input power to dc power for the inverter and for float charging the battery. The inverter continuously converts the dc power to ac power to supply the critical load. The inverter output must synchronize with the bypass ac power source, provided that the bypass ac power source is within the specified voltage and frequency range.

2.2.2 Battery - Emergency Operation (Loss or deviation of AC Input Power)

Whenever the ac input power source deviates from the specified tolerances including complete failure, the inverter must draw power from the battery system and supply AC power to the critical load without any interruption or switching transient. The battery system must supply power to the inverter for the specified protection time or until return of ac input source. Provide an audible alarm to indicate the UPS is on battery and provide provisions for a remote alarm signal to be sent via the communication network and a relay output, allowing startup of a secondary power source or orderly shutdown of the critical load.

2.2.3 Failure of AC Input Power to Return

If the ac input power fail to return before the battery voltage reaches the discharge limit, then the UPS system must disconnect from the critical load to safeguard the battery.

2.2.4 Recharge

Upon restoration of normal power to the UPS unit, the input converter and output inverter must simultaneously recharge the batteries and provide regulated power to the critical load.

2.2.5 Transfer to Static Bypass AC Power Source

When the UPS controller senses an overload, two or more inverter shutdown signals or degradation of the inverter output, the static bypass switch automatically transfers the critical load from the inverter output to the bypass ac power source without an interruption of power. If the static

bypass ac power source is outside of specified tolerance limits, the UPS and the critical load shut down. Transfer to static bypass can also be done manually (requested bypass). Transfer to bypass does not take place under these conditions: 100% stepload; and, loss or return of input power, momentary sags, surges or spikes on the input to the UPS.

2.2.6 Transfer to Inverter

Provide a static bypass switch that is capable of automatically transferring the load back to the inverter output after the inverter overload condition has returned to normal conditions. Transfer only occurs once the two sources are synchronized. UPS system logic is to monitor the number of retransfer's within any one-hour period and is to allow 1 to 3 transfers in order to prevent cyclical transfers caused by overloads.

2.2.7 Off-Battery (Battery Maintenance)

Provide a battery protective device which disconnects the battery from the rectifier/charger and inverter for maintenance. The device may be located external to the UPS cabinet. The UPS module continues to function and meet the performance criteria specified except for the battery back-up time function.

2.2.8 Component Performance

Do not exceed 75% of the working voltage and current ratings as established by the manufacturer on solid-state power components and electronic devices. Do not exceed 75% of the operating temperature of solid-state component sub-assemblies. Use computer grade electrolytic capacitors and operate at no more than 95% of the voltage rating at the rectifier charging voltage.

2.3 GENERAL UPS SYSTEM COMPONENTS AND FABRICATION

2.3.1 Semiconductor Fusing

Protect power semiconductors with fast-acting fuses to prevent cascaded or sequential semiconductor failures. Bolt fuses at both ends to bus bars to ensure mechanical and electrical integrity. Indicator lamp or display panel denoting blown fuse conditions must be readily observable by the operator without removing panels or opening cabinet doors.

2.3.2 EMI/RFI Protection

Provide an UPS that complies with and is labeled compliant, with FCC Part 15, Subclass B, Class A.

2.3.3 Internal Wiring

Wiring practices, materials, and coding must be in accordance with the requirements of NFPA 70, OSHA, UL 1778, and other applicable standards. Protect wire runs in a manner which separates power and control wiring. Provide control cabling that is at least No. 16 AWG extra-flexible stranded copper. Logic-circuit wiring may be smaller. Provide ribbon cables that are at least minimum No. 22 AWG. Provide control wiring with permanently attached wire numbers.

2.3.4 Internal Assembly

The printed circuit board (PCB) subassemblies are to be mounted in pull-out swing-out trays where feasible. Provide cable connections to the trays that are sufficiently long to allow easy access to all components. Where not feasible to mount PCB subassemblies in pull-out or swing-out trays, then mount them firmly mounted inside the enclosure. Monitor every PCB subassembly. Include self-test and diagnostic circuitry in the logic circuits such that a fault can be isolated down to the PCB subassembly level. When used, control logic cards are to have test points or logic indicators on the front edge of the control logic card and be labeled.

2.3.5 Cable Lugs and Terminations

2.3.5.1 Cable Lugs

Provide appropriate compression type lugs or pre-drilled bus bars on all ac and dc power connections to the UPS system and battery as required. Aluminum or bare copper cable lugs are not suitable.

2.3.5.2 Terminations

Supply terminals for making power and control connections. Provide terminal block for field wiring terminals. Provide terminal blocks that are the heavy-duty, strap-screw type or screw terminals that are integrated into removable plugs. Locate terminal blocks for field wiring in one place in each module. Extend control wiring to the terminal block location. Any terminal point is limited to land a maximum of two wires. Where control wiring is attached to the same point as power wiring, Provide a separate terminal where control wiring is attached to the same point as power wiring. If bus duct is used, provide bus stubs where bus duct enters cabinets.

2.3.6 Cabinets

Install the UPS system in cabinets of heavy-duty structure meeting the NEMA PE 1 standards for floor mounting. Provide a structurally adequate UPS module that can be forklift handled and lifted. Provide the UPS module cabinet with hinged and key lockable doors on the front only and with assemblies and components accessible from the front. Provide dead-front construction behind the door for those UPS module cabinets that are not lockable. Operating controls are to be located outside the locked doors. Install input, output, and battery cables through the top or bottom of the cabinet.

2.3.6.1 Factory Applied Finish

Provide electrical equipment with a factory-applied painting systems which, as a minimum, meets the requirements of NEMA 250 corrosion-resistance test.

2.3.7 Manufacturer's Nameplates

Provide a nameplate for each item of equipment bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.3.8 Field Fabricated Nameplates

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Provide an inscription on each nameplate that identifies the name of the item, calculated short circuit rating with date, and source of power e.g. 'Panel A in Electrical Room 103'. Provide nameplates that are made of melamine plastic, 0.125 inch thick, white with black center core. Provide the nameplate with a surface that is matte finished and that has square corners. Accurately align lettering and engrave into the core. Provide nameplates that are at least 1.0 by 2.5 inches with a minimum lettering size of 0.25 inch high normal block style.

2.3.9 Safety

Provide UPS with instruction plates including warnings and cautions, suitably located, and describing any special or important procedures to be followed in operating and servicing the equipment. Provide control panel displays, which also provide warning messages prior to performing a critical function.

2.3.9.1 Maintenance Isolation

All energized terminals, both AC and DC, and control voltage exposed points are to be insulated or enclosed to ensure the safety of maintenance personnel. Provide the system with the ability to isolate the static switch to enable repair when the UPS is bypassed.

2.4 TECHNICAL REQUIREMENTS UPS SYSTEM RATINGS

Unless stated otherwise, the parameters listed are under full output load over the range of 0.9 lagging power factor to 0.9 leading power factor, with batteries fully charged and floating on the dc bus and with nominal input voltage.

2.4.1 System Requirements

The UPS is to support and maintain full battery charging under the following conditions: indicated environmental conditions, a.c input voltage range, air filters blocked up to 50% and a single failed fan. The UPS size and configuration is indicated below.

Single Module (non-redundant). Provide one UPS sized as indicated on drawings.

2.4.2 Battery Capacity

Discharge time to end voltage: 10 minutes, at 77 degrees F. Provide a battery that is capable of delivering 125 percent of full rated UPS kW load at 0.9 power factor at initial start-up.

2.4.3 Static Switch

120 amperes (continuous duty)

2.4.4 Short Circuit Withstand Rating

Braced for at least 30,000 amperes symmetrical interrupting capacity.

2.4.5 AC Input

a. Voltage 208 volts line-to-line.

- b. Number of phases: Three-phase + ground configuration.
- c. Voltage Range: Plus 15 percent, minus 15 percent nominal (no battery discharge), without affecting battery float voltage or output voltage.
- d. Frequency: 60 Hz, plus or minus 5 percent.
- e. Power walk-in: 20 percent to 100 percent input current over 10 to 15 seconds.
- f. Total harmonic current distortion (THD) reflected into the primary line: 5 percent maximum at full load.
- g. Input surge protection: per IEEE C62.41.1 and IEEE C62.41.2, meeting IEEE C62.41 requirement of Category B3 6kV, 100k Hz ring wave and 6kV, combined wave.
- h. Input power factor: Lagging from 1-100 percent load.

2.4.6 AC Output

- a. Voltage 208 volts line-to-line, 120 volts line-to-neutral.
- b. Number of phases: Three-phase + neutral + ground configuration.
- c. Voltage regulation:
 - (1) Balanced load: Plus or minus 1.0 percent.
 - (2) 50 percent load imbalance, phase-to-phase: Plus or minus 2 percent.
 - (3) 100 percent load imbalance, phase-to-phase Plus or minus 3 percent.
 - (4) Voltage drift: Plus or minus 1 percent over any 30 day interval (or length of test) at stated ambient conditions found in paragraph Environmental Conditions.
- d. Voltage adjustment: Plus or minus 5 percent.
- e. Frequency: 60 Hz.
- f. Frequency regulation: Plus or minus 1 percent, when on internal oscillator. Internal oscillator is to be temperature compensated.
- h. Harmonic content (RMS voltage): Provide a system that meets the following voltage THD levels: maximum of 4% RMS total, 2 percent total with 100 percent on any single harmonic (linear load) and 5 percent RMS total for up to 100 percent nonlinear load.
- i. Load power factor operating range (without derating): 0.8 leading to 0.8 lagging.
- j. Inverter overload capability (at full voltage with plus or minus 2 percent regulation) (excluding battery):

Double Conversion mode: The unit shall maintain voltage regulation for 102% to <110% of resistive/inductive load for 10 minutes, 111% to <125% for 60 seconds, and 126% to 150% for 10 seconds, >151%

for 300ms.

k. Bypass Overload Capability.

On bypass (single UPS systems): Continuous = 125%. Transient = 1000% peak current for 10ms.

2.4.7 Transient Response

2.4.7.1 Voltage Transients

- a. Transient voltage response shall be per EN62040-3, Class 1, VFI-SS-111.
- b. Transient voltage recovery shall be compliant to EN62040-3, Class 1, VFI-SS-111.

2.4.7.2 Frequency

- a. Transients: Plus or minus 0.6 Hz maximum.
- b. Slew Rate: under all conditions of operation, provide 0.4 to 1.0 Hz per second.

2.4.8 Efficiency

- a. Minimum Single-Module Efficiency: 95 percent at full load kW and 95 percent at 50 percent load.

2.5 STATIC BYPASS TRANSFER CIRCUIT

Provide the control logic with an automatic transfer circuit that senses the status of the inverter logic signals and alarm conditions and provides an uninterrupted transfer of the load to the static bypass ac power source, without exceeding the transient limits specified herein, during times when maintenance is required, when a malfunction occurs in the UPS or when an external overload condition occurs. The static bypass transfer circuit is to be used to connect the input bypass ac power source to the critical load when required. Provide the static bypass transfer circuit with the following features:

2.5.1 Construction

Provide a static with a continuous duty rating of at least 100 percent of the UPS output rating. Provide a static bypass transfer circuit as an integral part of the UPS that consists of a static switch, made up of two reverse-paralleled SCRs (silicon-controlled rectifiers) per phase conductor, and a bypass protective device, made up of a circuit breaker. The bypass protective device is to be in series with the static switch. The inverter output protective device disconnects and isolates the inverter from the bypass transfer circuit.

2.5.2 Automatic Uninterrupted Transfer

The static bypass transfer switch automatically causes the bypass ac power source to assume the critical load without interruption when the bypass control logic senses one of the following conditions and the UPS inverter output is synchronized to the bypass ac power source:

- a. Inverter overload exceeds unit's rating.

- b. Battery protection period is expired and bypass is available.
- c. System failure.
- d. Inverter output undervoltage or overvoltage.

2.5.3 Interrupted Transfer

If an overload occurs and the UPS inverter output is not synchronized to the bypass ac power source, the UPS inverter output current-limits for 200 milliseconds minimum. The inverter then turns off and an interrupted transfer to the bypass ac power source is made.

If the bypass ac power source is beyond the conditions stated below, an interrupted transfer is made upon detection of a fault condition:

- a. Bypass voltage greater than plus or minus 10 percent from the UPS rated output voltage.
- b. Bypass frequency greater than plus or minus 0.5 Hz from the UPS rated output frequency.
- c. Phase differential of ac bypass voltage to UPS output voltage greater than plus or minus 3 degrees.

2.5.4 Manual Load Transfer

It must be possible to make a manually-initiated static transfer from the system status and control panel by turning the UPS inverter off or by initiating it through the UPS display interface. The transfer is to make-before-break utilizing the UPS output and system bypass circuit breakers. Do not use the static switch for manual transfer unless there isn't a parallel by-pass circuit breaker or contactor.

2.5.5 Automatic Uninterrupted Forward Transfer

Automatic transfer of the load back to the inverter is to take place when the transfer was caused by an overload and only after the load has returned to a level within the inverter souse. Provide the ability to allow 1 to 3 transfers within any one-hour period to prevent cyclical transfers caused by overloads.

2.5.6 Forced Transfer

Provide control logic circuitry with the means of making a forced or reverse transfer of the static bypass transfer circuit on an interrupted basis. Minimum interruption is 200 milliseconds when the UPS inverter is not synchronized to the bypass ac power source.

2.5.7 Overload Ratings

The static bypass transfer switch is to withstand the following overload conditions:

- a. On bypass (single UPS systems): Continuous = 125%. Transient = 1000% peak current for 10ms.

2.5.8 System Protection

Incorporate into the static bypass circuit back-feed protection per UL 1778. To achieve back-feed protection, provide a back-feed protection breaker/mechanical contactor upstream and in series with the bypass switch that is controlled by the UPS/static switch, to open immediately upon sensing a condition where back-feeding of the static switch by any source connected to the critical output bus of the system is occurring.

2.5.9 Static Bypass Switch Disconnect

Incorporate a static switch disconnect that can be used to isolate the static bypass transfer switch assembly so it can be removed for servicing.

2.6 DISPLAY, CONTROLS AND ALARMS

Provide the UPS module with a microprocessor-controlled display unit located on the hinged door on the front of the system. Provide a LCD color alphanumeric display that operated by touchscreen to access the various information. Controls, meters, alarms and indicators for operation of the UPS module are to be on this panel. Provide a menu driven graphical user interface for browsing the screens. All three-phases of three-phase parameters are to be displayed simultaneously.

2.6.1 Module Meters

2.6.1.1 Monitored Functions

Display the actual value along with the ability to show the peak, average and low values over various periods of time. Monitor and display the following functions:

- a. Input voltage, phase-to-phase (all three phases).
- b. Input current, all three phases.
- c. Input frequency.
- d. Bypass voltage, phase-to-phase and phase-to-neutral (all three phases).
- e. Bypass frequency.
- f. Battery voltage.
- g. Battery current (charge/discharge).
- h. Output voltage, phase-to-phase and phase-to-neutral (all three phases).
- i. Output current, all three phases.
- j. Output frequency.
- k. Input power factor.
- l. Maintenance bypass voltage, phase-to-phase and phase-to-ground (all three phases)

2.6.1.2 Meter Construction

Display alphanumeric parameters based on true RMS metering with 2 percent

accuracy at full scale(minimum 4 significant digits) at the display panel.

2.6.2 Module Controls

Provide a module or equivalent features via touchscreen with the following controls:

- a. Silence audible alarm.
- b. Display or set the date and time.
- c. Adjust setpoints on various alarms.
- d. Alarm test/reset pushbutton.
- e. Battery protective device trip pushbutton, with guard.
- f. Emergency off pushbutton, with guard. Provide a hard-wired pushbutton even if touchscreen system is provided.
- g. DC voltage adjustment potentiometer, with locking guard or AC output voltage adjustment potentiometer. Provide potentiometer that is accessible only by authorized personnel.
- h. Control power off switch.
- i. Transfer load to and from static bypass circuit.
- j. Display control pushbuttons: up, down, select.

2.6.3 Module or System Alarm Indicators

Provide the module with indicators for the following alarm items. Any one of these conditions is to turn on an audible alarm and the appropriate summary indicator. The system is to register each new alarm without affecting any previous alarm. Provide a processor that time-date stamps each event.

- a. Input ac power source failure.
- b. Input protective device open.
- c. Input power out of tolerance.
- d. Overload.
- e. Overload shutdown.
- f. DC overvoltage/shutdown.
- g. DC ground fault.
- h. Low battery.
- i. Battery discharged.
- j. Battery protective device open.

- k. Blower fan failure or overtemperature.
- l. Overtemperature shutdown.
- m. Hardware shutdown.
- n. Equipment overtemperature.
- o. Fuse blown with annunciation..
- p. Control power failure.
- q. Charger off/problem.
- r. Inverter fault/off.
- s. Emergency power off.
- t. External shutdown (Remote Emergency Power Off) activated.
- u. Output protective device open.
- v. Operating on internal oscillator
- w. UPS on battery
- x. Critical load on static bypass.
- y. Static bypass transfer switch disabled/failure.
- z. Inverter output overvoltage.
- aa. Inverter output undervoltage.
- bb. Inverter output overfrequency.
- cc. Inverter output underfrequency.
- dd. Bypass source overvoltage.
- ee. Bypass source undervoltage.
- ff. Bypass source overfrequency.
- gg. Bypass source underfrequency.
- hh. Bypass source to inverter out of synchronization.

2.6.4 Module Emergency OFF Button

Provide an emergency off pushbutton with a protective cover. Pressing the emergency off button causes the module input, output, and battery circuit breakers or contactors to open, completely isolating the UPS system from sources of power and transfer of the load to bypass.

System Mimic Panel

Provide a mimic panel in the format of a single-line diagram that graphically depicts whether the load is supplied from the inverter,

bypass, or battery. Provide on status on the following:

- a. Module on-line, one per UPS module.
- b. UPS output protective device status, one for closed (red), one for open (green), and one for withdrawn (amber).
- c. Static bypass protective device status, one for closed (red), one for open (green), and one for withdrawn (amber).
- d. Static switch status, one for connected (red), and one for disconnected (green).
- e. Status on the AC input circuit breaker, battery circuit breaker, and inverter circuit breaker. Connected (red) and disconnected (green).

2.7 COMMUNICATIONS AND DATA ACQUISITION

Provide an Internet Protocol (IP) communications and data acquisition port. This port allows the system parameters, status, alarm indication and control panel functions specified to be remotely monitored and controlled.

Additionally, provide additional ports for use with the following:

- a. Provide the following Form C contacts for remote indication:

- (1) UPS on battery.
- (2) UPS on-line.
- (3) UPS load on bypass.
- (4) UPS in alarm condition.
- (5) UPS off (maintenance bypass closed).

- b. Provide four spare Form C contacts rated at 120V, 0.5A.

Provide communication ports and contacts that are capable of simultaneous communication.

2.8 BATTERY SYSTEM

2.8.1 General

Battery system contains the battery cells, cabinets, battery disconnect. Provide a storage battery with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration for each UPS module. Provide a battery that is heavy-duty, industrial design suitable for UPS service. Provide the cells with flame arrestor vents, intercell connectors and cables, cell-lifting straps, cell-numbering sets, and terminal grease. Size intercell connectors to maintain terminal voltage within voltage window limits when supplying full load under power failure conditions. Provide cell and connector hardware that is the type of stainless steel capable of resisting corrosion from the electrolyte used. The battery plant is to consist of the following:

- a. Provide a lead calcium battery that is of the float-type, absorbed

glass mat (AGM) valve-regulated, lead-acid, sealed, non-gassing, recombinant type (VRLA) that is rated for 10 years. Provide the UPS battery plant of modular construction made up of replaceable, hot-swappable, fused, battery modules.

2.8.2 Battery Cabinet

Furnish the battery pack assembly in a battery cabinet matching the UPS cabinet. Design the battery cabinet to allow for checking the torque on the connections in the battery system and to provide adequate access for annual housekeeping chores. Provide an external wiring interface through the bottom or top of the assembly. Provide a high temperature alarm that annunciates detection of high temperature within the battery cabinet.

2.8.3 Battery Disconnect

Provide each battery cabinet with a circuit breaker.

2.9 FACTORY TESTING

Factory test the UPS system to meet the requirements specified using a test battery (not the battery to be supplied with the system) or D.C. simulator. Factory load test the UPS module as an independent assembly with 3-phase ac input power and with battery power for a minimum of 8 hours, with meter readings taken every 30 minutes. Balance the load at rated kVA and rated power factor.

- a. Submit a detailed description of proposed factory test and field test procedures, including proposed dates and steps outlining each test, how it is to be performed, what it accomplishes, and its duration, not later than 1 months prior to the date of each test.
- b. Run the factory test for each UPS module under full load that is witnessed by the Government. Should a malfunction occur, correct the problem and repeat the test. As a minimum, the factory tests are to include the parameters described in paragraphs ac Input, ac Output, Transient Response and Efficiency. Tests are to encompass all aspects of operation, such as module failure, static bypass operation, battery failure, input power failure and overload ratings.
- c. Notify the Government in writing at least 2 weeks before testing. Do not use factory-test time for system debugging and/or checkout. Perform such work prior to notifying the Government that the system is ready for testing. Perform factory tests during normal business hours. Interconnect and test the system for an additional 8 hours to ensure proper wiring and performance.
- d. Submit factory and field test reports in booklet form tabulating factory and field tests and measurements performed, upon completion and testing of the installed system. An official authorized to certify on behalf of the manufacturer of the UPS system that the system meets specified requirements will sign the factory and field test reports. Date each report after the award of this contract, which states the Contractor's name and address, name the project and location, and list the specific requirements, which are being certified.

2.9.1 Transient Tests

Conduct transient tests using high-speed oscillograph type recorders to demonstrate the operation of the components to the satisfaction of the Government. These tests consist of 50 percent to 100 percent load changes, manual transfer, manual retransfer, low dc bus initiated transfer and low ac output bus transfer. Use a recording instrument equipped with an event marker.

2.9.2 Efficiency Tests

Perform testing for efficiency at zero output up to 100 percent of stated kW output in 25 percent steps with battery fully charged and floating on the dc bus, with nominal input voltage, and with module connected to represent actual operating conditions.

PART 3 EXECUTION

3.1 INSTALLATION

Conform electrical installations to IEEE C2, NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise. Set the UPS system in place that is wired and connected in accordance with the approved shop drawings and manufacturer's instructions.

3.1.1 Control Cable

Install UPS control wiring in individual separate rigid steel conduits, unless connections are made between side by side matching cabinets of UPS. Tag control wires with numeric identification tags corresponding to the terminal strip location to where the wires are connected. In addition to manufacturer's requirements, provide four additional spare conductors between UPS module and remote alarm panel in same conduit. When routing control cables inside UPS module, maintain a minimum 6 inches separation from power cables.

3.1.2 Grounding

3.1.2.1 Grounding Conductor Title

Provide a separate grounding conductor that is separate from the electrical system neutral conductor in feeder and branch circuits. Ground battery racks and battery breaker cabinets with a separate equipment grounding conductor to the UPS cabinet.

3.1.2.2 Separately Derived

If not part of a listed power supply for a data-processing room, comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic pipe.

3.1.3 UPS Output Conductors

Isolate the UPS output conductors from the UPS cabinet to the critical load panels and from other conductors by installing in separate conduit.

3.1.4 Conduit Entries

Ensure conduit entries use the available conduit areas shown on manufacturer's installation drawings. Do not make conduit entries through the front, side or rear panels of the UPS or battery cabinet.

3.1.5 Battery Cabinet Assembly

Conform battery rack installation to the manufacturer's instructions.

3.1.6 Battery Installation

Conform battery cabinet installation to the manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

Notify the Contracting Officer in writing at least 30 calendar days prior to completion of the UPS system installation. At this time the Contractor, will schedule the UPS manufacturer's technical representative to inspect the completed installation. Provide instruction for activity personnel by the UPS technical representative as specified in paragraph titled "DEMONSTRATION".

3.2.1 Installation Preparation

Completely install the following items by the Contractor and be operational prior to the arrival of the UPS representative for inspection, unit start-up and testing:

- a. Ventilation equipment in the UPS and battery rooms.
- b. Battery cabinets and cells.
- c. Battery connections including cell-to-cell, tier-to-tier, and rack-to-rack connections, with correct polarity;
- d. DC power and control connections between UPS and battery circuit breaker, with correct polarity;
- e. DC power connection between battery circuit breaker and battery, with correct polarity;
- f. Clockwise phase rotation of ac power connections;
- g. AC power to rectifier input bus;
- h. AC power to UPS bypass input bus;
- i. AC power to UPS maintenance bypass circuit breaker;
- j. AC power from UPS output to UPS maintenance bypass output circuit breaker;
- k. Remote monitors and control wiring;
- l. UPS system and battery system properly grounded;
- m. Control connections between UPS module ;

- n. Clean and vacuum UPS and battery room floors, battery cells, and UPS equipment, both inside and outside;
- o. Ensure that shipping members have been removed.

3.2.2 Initial Inspection and Tests

The UPS technical representative and the Contracting Officer, in the presence of the Contractor, will inspect the completed installation. The Contractor is responsible to correct construction or installation deficiencies as directed. Perform acceptance checks in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections, performed in accordance with NETA ATS.

a. UPS Unit visual and mechanical inspection

- (1) Compare equipment nameplate data with drawings, specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition. Inspect doors, panels, and sections for paint, dents, scratches, fit, and missing hardware. Inspect the displays for scratches, dark pixels or uneven brightness.
- (3) Inspect anchorage, alignment, grounding, and required clearances.
- (4) Verify that fuse sizes and types correspond to drawings.
- (5) Verify the unit is clean inside and out.
- (6) Test all electrical and mechanical interlock systems for correct operation and sequencing.
- (7) Inspect bolted electrical connections for high resistance using one of the following methods:
 - (a) Use a low-resistance ohmmeter.
 - (b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - (c) Perform thermographic survey.
- (8) Verify operation of forced ventilation.
- (9) Verify that vents are clear and new clean filters are installed.
- (10) Inspect batteries and chargers according to requirements in NETA ATS

b. UPS Batteries visual and mechanical inspection

- (1) Compare equipment nameplate data with drawings, specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition. Inspect doors, panels, and sections for paint, dents, scratches, fit, and missing hardware. Inspect the displays for scratches, dark pixels or uneven brightness.

- (3) Inspect anchorage, alignment, grounding, and required clearances.
- (4) Verify that fuse sizes and types correspond to drawings.
- (5) Verify the unit is clean inside and out.
- (6) Verify the application of an oxide inhibitor on battery terminal connections.
- (7) Inspect bolted electrical connections for high resistance using one of the following methods:
 - (a) Use a low-resistance ohmmeter.
 - (b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - (c) Perform thermographic survey.

3.2.3 Performance Tests

Provide equipment, test instruments, power, load bank, materials and labor required for tests. Contracting Officer will witness all tests and the tests are subject to his approval. Perform tests in accordance with the manufacturer's recommendations and include the following electrical tests.

3.2.3.1 UPS Unit Performance Tests

Upon completion of battery activation procedures, Contractor is to connect load bank to UPS output. Size load bank to the full kW rating of the system.

Performance test is to be run under the supervision of the UPS technical representative. Operate UPS unit under full kW load for a minimum of one hour. Operation of the feeder and bypass power feeder breakers during testing of the UPS is the responsibility of the Contractor.

a. Electrical Tests

- (1) Test static transfer from inverter to bypass and back. Use normal load, if possible.
- (2) Test dc undervoltage trip level on inverter input breaker/relay. Set according to manufacturer's published data.
- (3) Test alarm circuits.
- (4) Verify synchronizing indicators for static switch and bypass switches.
- (5) Perform electrical tests for UPS system breakers.
- (6) Perform electrical tests for UPS system batteries.
 - (a) Measure negative post temperature.
 - (b) Measure charger float and equalizing voltages.

(c) Verify all charge functions and alarms.

b. Test Values

Verify bolt-torque levels.

c. Maintenance Bypass Panel/Cabinet

Verify interlocks (Kirk-Key or other means) operate properly. Verify that the breaker arrangement operates in the manner required for the number of possible combinations.

d. Load Test

Load test the installed system for a continuous 24 hour period by means of resistive load banks. Continuously test the system at 1/2 load for 8 hours, 3/4 load for 8 hours and full load for 8 hours. Provide variable load banks sized to the full kW load of system to facilitate startup under load conditions, and to conduct load tests described above. Record instrument readings every half hour for the following:

- (1) Input voltage (all three phases).
- (2) Input current (all three phases).
- (3) Input frequency.
- (4) Battery voltage.
- (5) Output voltage (all three phases).
- (6) Output current (all three phases).
- (7) Output kilowatts.
- (8) Output frequency.

3.3 DEMONSTRATION

3.3.1 Instructing Government Personnel

Furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors are to be thoroughly familiar with all parts of the installation and be trained in operating theory as well as practical operation and maintenance work. Provide instruction during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. Provide 8 hours of instruction for NOAA personnel. Provide a factory training video or on-line training as part of the training materials.

3.4 FINAL ADJUSTMENTS

- a. Remove load bank and reconnect system for normal operation.
- b. Equalize battery per manufacturer instructions.

- c. Resume charging battery at normal float voltage as defined by battery manufacturer recommendations.
- d. Prior to charging, check battery connections are properly torque to manufacturer's specifications. Take and record, for cell-to-cell and terminal connections, detailed micro-ohm resistance readings. Remake connections having a resistance of more than 10 percent above the average.
- e. Deliver all manufacturer's data and operation manuals, which are an integral part of, and shipped with UPS, to Contracting Officer.

3.5 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.6 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting is to comply with Section 09 90 00 PAINTS AND COATINGS.

-- End of Section --

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES AND BY-PASS/ISOLATION SWITCH
05/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B117 (2019) Standard Practice for Operating
Salt Spray (Fog) Apparatus

ASTM D709 (2017) Standard Specification for
Laminated Thermosetting Materials

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2017; Errata 2017) Standard for
Acceptance Testing Specifications for
Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2018) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NEMA ICS 2 (2000; R 2005; Errata 2008) Industrial
Control and Systems Controllers,
Contactors, and Overload Relays Rated 600 V

NEMA ICS 4 (2015) Application Guideline for Terminal
Blocks

NEMA ICS 6 (1993; R 2016) Industrial Control and
Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20 (2019) Standard for the Installation of
Stationary Pumps for Fire Protection

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 110 (2016) Standard for Emergency and Standby
Power Systems

UNDERWRITERS LABORATORIES (UL)

UL 508 (2018) UL Standard for Safety Industrial

Control Equipment

- UL 1008 (2014) Transfer Switch Equipment
- UL 1066 (2012; Reprint Mar 2017) UL Standard for Safety Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, and Section 26 08 00 APPARATUS INSPECTION AND TESTING, applies to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Automatic Transfer Switch Drawings; G

SD-03 Product Data

Automatic Transfer Switches; G

SD-06 Test Reports

Acceptance Checks and Tests

Functional Acceptance Tests

Factory Testing

Factory Test Reports

SD-07 Certificates

Proof of Listing

SD-10 Operation and Maintenance Data

Operation and Maintenance Manual, Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, Data Package 5; G

1.4 OPERATION AND MAINTENANCE MANUAL

Assemble and bind manuals in durable, hard-covered, water resistant binders. Assemble and index the manuals per the following table of contents:

- a. Manufacturer's O&M per "SD-10 Operation and Maintenance Data".
- b. Catalog data required by "SD-03 Product Data"
- c. Drawings required by "SD-02 Shop Drawings".

1.4.1 Additions to Operation and Maintenance Manuals

In addition to requirements of SD-10 Data Package 5, include the followings on the actual equipment provided:

- a. An outline drawing, front, top, and side views.
- b. Prices for spare parts and supply list.
- c. Date of Purchase.
- d. Corrective maintenance procedures.
- e. Operating manual outlining step-by-step procedures for system startup, operation, and shutdown.
- f. Include simplified wiring and control diagrams in the manual for system as installed.
- g. Provide typical contact voltage drop readings under specified conditions for use during periodic maintenance. Provide instructions for determination of contact integrity.

1.5 QUALITY ASSURANCE

1.5.1 Proof of Listing

Submit proof of listing by UL 1008.

1.5.2 Automatic Transfer Switch Drawings

Include the following as a minimum:

- a. An outline drawing, including front, top, and side views.
- b. Provide a nameplate of corrosion-resistant material with not less than 1/8 inch tall characters showing manufacturer's name and equipment ratings. Mount nameplate to front of enclosure and meet the nameplate requirements of NEMA ICS 2.
- c. Provide detail drawings that include manufacturer's name and catalog number, electrical ratings, total system transfer statement, reduced normal supply voltage at which transfer to the alternate supply is initiated, transfer delay times, short-circuit current rating, wiring diagram, description of interconnections, testing instructions, acceptable conductor type for terminals, tightening torque for each wire connector, and other required UL 1008 markings.
- d. Submit interface equipment connection diagram showing conduit and wiring between ATS and related equipment. Provide diagrams showing interlocking provisions and cautionary notes, if any.
- e. Drawings are to indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory

provisions to be mandatory, as though the word "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated

1.5.4 Standard Product

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record are acceptable if the manufacturer has been regularly engaged in the design and production of automatic transfer switches and if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 years prior to date of delivery to site are not acceptable.

1.6 DELIVERY AND STORAGE

Protect equipment placed in storage from humidity and temperature variations, moisture, water intrusion, dirt, dust, or other contaminants. In harsh environments where temperatures exceed non-operational parameters established within this specification, provide an environmentally controlled equipment storage facility to ensure temperature parameters are within equipment specification. Provide documentation of same to the Government when storage is implemented.

1.7 ENVIRONMENTAL CONDITIONS

Provide an ATS that is suitable for prolonged performance under following service conditions:

- a. Operating altitude: Sea level to 3,300 ft. (Systems applied at higher altitudes are to be derated in accordance with the manufacturer's instructions).
- b. Operating ambient temperature range: 40 to 104 degrees F.

- c. Operating relative humidity: 0 to 90 percent, without condensation.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCHES

Each automatic transfer switch must be rated and marked for total system transfer and have the current and voltage ratings as indicated. Provide a switch operating mechanism that is electrically operated, have quick-make, quick-break, load break contacts, and be mechanically held in both positions. Switches utilizing circuit breakers are not acceptable. Provide an ATS that is UL listed. ATS must be manufactured and tested in accordance with applicable requirements of NEMA ICS 2, UL 1008 and UL 1066. ATS must conform to NFPA 110. Provide the ATS with the following characteristics:

- a. Voltage: As indicated.
- b. Amperage: As indicated. Provide an ATS with a continuous load current rating of the switch rating.
- c. Number of Phases: Three.
- d. Number of Wires: Four.
- e. Frequency: 60 Hz.
- f. Poles: Four switched.
- g. ATS Withstand Current Rating: Rated to withstand closing current short-circuit current as indicated.
- h. Nonwelding Contacts: Provide contacts that are nonwelding at the available fault current rating.
- i. Phase and Neutral Contacts: Provide contacts with silver alloy composition. Provide neutral contacts with the same continuous current rating as main or phase contacts.
- j. Configuration. Provide an ATS for use in emergency systems described in NFPA 70. Provide an ATS that is listed for emergency use.
- k. ATS Configuration. Provide an open transition ATS.
- l. Fire Pump Service. Provide a manual operating means that is externally operable without opening the enclosure on transfer switches for fire pump service. The manual means is to open and close the switch contacts at the same rate of speed as that caused by the automatic operation of the switch. The ATS is to meet the requirements found in NFPA 20.

2.1.1 Undervoltage Sensing - Normal/Preferred Source

Undervoltage Sensing - Normal Source. Provide undervoltage sensing for each phase in the normal/preferred source. Sense low phase-to-ground voltage on each phase. Provide sensing circuit with adjustable dropout, 75-98 percent of nominal value and adjustable pickup, 85-100 percent of nominal value. Factory set dropout value to 85percent. Factory set pickup value to 95percent.

2.1.1.2 Adjustable Time Delay - Override Transfer

Adjustable Time Delay - Override Transfer. For override of normal-source voltage sensing to delay transfer and engine starting signals. Engine starting control contacts with adjustable commit-to-start delay circuit, 0.0-6.0 seconds. Factory set at 1second.

2.1.1.3 Voltage/Frequency Lockout Relay - Alternate/Emergency Source

Voltage/Frequency Lockout Relay. Prevent premature transfer to alternate/emergency source. Provide pickup voltage that is adjustable from 85-100 percent of nominal. Factory set for pickup at 90 percent. Provide pickup frequency that is adjustable from 90-97 percent of nominal. Factor set frequency pickup for 95 percent.

2.1.1.4 Adjustable Time Delay - Transfer to Alternate/Emergency Power Source

Adjustable Time Delay - Transfer to Alternate Power Source. Transfer to alternate power source time delay for transfer switches as indicated, adjustable 0-5 minutes. Factory set to 0 seconds. ATS is to monitor the frequency and voltage of alternate power source and transfer when frequency and voltage are stabilized.

2.1.1.5 Adjustable Time Delay- Re-transfer to Normal/Preferred Source

Adjustable Time Delay- Transfer to Source. Re-transfer to normal source time delay, adjustable 0-30 minutes. Factory set at 10 minutes. Time delay is automatically defeated upon loss or sustained undervoltage of alternate power source, provided that normal source has been restored.

2.1.1.6 Engine Shutdown Time Delay

Engine Shutdown. Provide time delay that is adjustable from 0 to 5 minutes and is factory set at 5 minutes.

2.1.1.7 Engine Starting Contacts

Provide 2 isolated normally closed and 2 isolated normally open contact that is rated 5 A at 250 VAC/30 VDC minimum.

2.1.1.8 Controls for Fire Pump Service Automatic Transfer Switch

Provide the following additional controls features:

Phase reversal of the normal source is to initiate transfer to the emergency/alternate source.

2.1.1.9 Delayed Transition With Time Delay Neutral

Provide an adjustable time delay transition for indicated transfer switches to allow safe transfer of highly inductive loads between two non-synchronized sources. This transfer between loads has a programmed neutral position arranged to provide a midpoint between the two working positions, with an intentional time-controlled pause at midpoint during transfer. Pause is adjustable from 1 to 300 seconds. Factory set time delay at 0.5 seconds. Time delay occurs for both transfer directions. Manufacturer is to provide recommendations for establishing the length of the time delay.

2.1.1.10 Unassigned Auxiliary Contacts

Provide two normally open and two normally closed, single-pole,

double-throw auxiliary contacts for each switch position rated at 10 amperes at 480 volts.

2.1.11 Front Panel Devices

Provide devices mounted on cabinet front consisting of:

- a. Mode selector switch with the following positions and associated functions. Selector switch can be part of the microprocessor controller consisting of an LCD screen with a graphical interface or as a stand-alone test switch.
 - (1) TEST - Simulates loss of normal/preferred source system operation.
 - (2) NORMAL - Transfers system to normal/preferred source bypassing re-transfer time delay.
- b. Switch position indicating lights or graphical LCD display. Indicate source to which load is connected.
- c. Source-Available Monitor. Provide source-available indicating lights or graphical LCD display monitor that is labeled to show when one or both sources of power are available. If indicating lights are used, then the preference is to have Green be normal/preferred power and Red be for alternate/emergency power; however, other color schemes are allowed if clearly marked.
- d. Provide a transfer override switch. Provide automatic transfer switch microprocessor based controller, which offers field selectable/adjustable inputs and outputs for transfer switch operation. Override switch must bypass automatic transfer controls so ATS will transfer and remain connected to emergency generator power source, regardless of condition of normal/preferred source. Provide an indicating light to show override status. If emergency source fails and normal source is available, ATS is to automatically retransfer to normal source.
- e. Lamp test button.

2.1.12 Voltage Unbalance

Provide automatic transfer switch controller or control logic to include positive and negative sequence voltage detection to identify a phase loss condition that can adversely effect motor loads.

2.2 ENCLOSURE

Provide an enclosure that meets the following:

- a. Provide ATS and accessories in a free-standing, floor-mounted, ventilated NEMA 250, Type 1, smooth sheet metal enclosure constructed in accordance with applicable requirements of NEMA ICS 6, UL 508, UL 1066, and UL 1008. Provide door with suitable hinges, locking handle latch, and gasketed jamb. Provide at least No. 14 metal gauge.
- b. Factory wiring within enclosure and field wiring terminating within enclosure must comply with NFPA 70. Provide wire that is permanently tagged or marked near terminal at each end with wire number shown on approved detail drawing, when wiring is not color coded. Conform

terminal block to NEMA ICS 4. Arrange terminals for entrance of external conductors from bottom of enclosure as shown. Main switch terminals, including neutral terminal if used, must be pressure type suitable for termination of external copper conductors shown.

2.2.1 Construction

Construct enclosure for ease of removal and replacement of ATS components and control devices from front without disconnection of external power conductors or removal or disassembly of major components.

2.2.2 Cleaning and Painting

Protect both the inside and outside surfaces of an enclosure, including means for fastening against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means. Protection is not required for metal parts that are inherently resistant to corrosion, bearings, sliding surfaces of hinges, or other parts where such protection is impractical. Provide manufacturer's standard finish material, process, and color that is free from runs, sags, peeling, or other defects. An enclosure marked Type 1, 3R, 4 or 12 is acceptable if there is no visible rust at the conclusion of a salt spray (fog) test using the test method in ASTM B117, employing a 5 percent by weight, salt solution for 24 hours. Type 4X enclosures are acceptable following performance of the above test with an exposure time of 200 hours.

2.2.3 Field Fabricated Nameplates

Nameplate is to comply with ASTM D709. Provide laminated plastic nameplates for each equipment enclosure as specified or as indicated on the drawings. Provide an inscription on each nameplate that identifies the name of the equipment, sources of power, calculated short circuit with date and the location e.g. 'SWB-1 Electrical Room 103'. Provide nameplates that are made of melamine plastic, 0.125 inch thick, white with black center core. Provide the nameplate with a surface that is matte finished and that has square corners. Accurately align lettering and engrave into the core. Provide nameplates that are at least 1.0 by 2.5 inches with a minimum lettering size of 0.25 inch high normal block style.

2.3 FACTORY TESTING

Submit a description of proposed field test procedures, including proposed date and steps describing each test, its duration and expected results, not less than 2 weeks prior to test date. Submit certified factory and field test reports, within 14 days following completion of tests. Provide reports that are certified and dated and that demonstrate that tests were successfully completed prior to shipment of equipment.

2.3.1 Prototype Factory Testing

A prototype of specified ATS is to be factory tested in accordance with UL 1008. In addition, perform factory tests on each ATS as follows:

- a. Insulation resistance test to ensure integrity and continuity of entire system
- b. Main switch contact resistance test.
- c. Visual inspection to verify that each ATS is as specified.

- d. Mechanical test to verify that ATS sections are free of mechanical hindrances.
- e. Electrical tests to verify complete system electrical operation and to set up time delays and voltage sensing settings.

2.3.2 Factory Test Reports

Provide three certified copies of factory test reports from the manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

Installation must conform to the requirements of NFPA 70 and manufacturer's recommendation.

3.2 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the automatic transfer switch.

3.2.1 Performance of Acceptance Checks and tests

Complete as specified in paragraph entitled "Acceptance Checks and Tests". The Acceptance Checks and Tests are to be accomplished by the Testing organization as described in Section 26 08 00 APPARATUS INSPECTION AND TESTING.

3.2.2 Manufacturers O&M Information

The manufacturers O&M information required by the paragraph entitled "SD-10 Operation and Maintenance Data", is to be submitted to and approved by the Contracting Officer.

3.2.3 Test Equipment

Ensure all test equipment and instruments is on hand prior to scheduling field tests, or subject to Contracting Officer's approval, evidence must be provided to show that arrangements have been made to have the necessary equipment and instruments on site prior to field testing.

3.3 FIELD QUALITY CONTROL

Give Contracting Officer 15 days notice of dates and times scheduled for tests which require the presence of the Contracting Officer. The Contracting Officer will coordinate with the using activity and schedule a time that will eliminate or minimize interruptions and interference with the activity operations. The contractor is responsible for costs associated with conducting tests outside of normal working hours and with incorporating special arrangements and procedures, including temporary power conditions. The contractor provides labor, equipment, apparatus, including test load, and consumables required for the specified tests. Calibration of all measuring devices and indicating devices must be certified. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section. The

manufacturer's representative is to provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly components contained herein. Provide a test load that is a cataloged product in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Perform the following field tests in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.3.1 Automatic Transfer Switch Acceptance Checks and Tests

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Confirm correct application of manufacturer's recommended lubricants.
- (4) Verify that manual transfer warnings are attached and visible.
- (5) Verify tightness of all control connections.
- (6) Verify tightness of accessible bolted connections by calibrated torque-wrench method. Thermographic survey is not required.
- (7) Perform manual transfer operation.
- (8) Verify positive mechanical interlocking between normal and alternate sources.

b. Electrical Tests

- (1) Measure contact-resistance. Correct values that exceed 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
- (2) Perform insulation-resistance on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole for one minute. Perform tests in both source positions.
- (3) Verify settings and operations of control devices.
- (4) Calibrate and set all relays and timers.
- (5) Test ground-fault protective device.

3.3.2 Functional Acceptance Tests

Functional Acceptance Tests must be coordinated with Section 26 32 15.00 ENGINE-GENERATOR SET STATIONARY 15-2500 KW, WITH AUXILIARIES. Functional Acceptance Test must be coordinated with Section 21 30 00 FIRE PUMPS. Include simulating power failure and demonstrating the following operations for each automatic transfer switch. Demonstrate in service that the automatic transfer switches are in good operating condition, and function not less than five times.

- a. Perform automatic transfer tests:
 - (1) Simulate loss of normal/preferred power.
 - (2) Return to normal/preferred power.
 - (3) Simulate loss of emergency/alternate power.
 - (4) Simulate all forms of single-phase conditions.
- b. Verify correct operation and timing of the following functions:
 - (1) Normal source voltage-sensing relays.
 - (2) Engine start sequence.
 - (3) Time delay upon transfer.
 - (4) Alternate source voltage-sensing relays.
 - (5) Automatic transfer operation.
 - (6) Interlocks and limit switch function.
 - (7) Time delay and retransfer upon normal power restoration.

3.3.3 Infrared Scanning

After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

- a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after acceptance.
- b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- c. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 TRAINING

Provide 4 hours of training to maintenance personnel on the proper operation, maintenance and adjustment of the automatic transfer switch. Coordinate this training with that of the generator equipment.

-- End of Section --

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SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM

11/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81 (2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 780 (2017) Standard for the Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 96 (2016) UL Standard for Safety Lightning Protection Components

UL 467 (2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment

UL Electrical Construction (2012) Electrical Construction Equipment Directory

1.2 RELATED REQUIREMENTS

1.2.1 Verification of Dimensions

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before making any departures from the design.

1.2.2 System Requirements

Provide a system furnished under this specification consisting of the latest UL Listed products of a manufacturer regularly engaged in production of lightning protection system components. Comply with NFPA 70, NFPA 780, and UL 96.

1.2.3 Lightning Protection System Installers Documentation

Provide documentation showing that the installer is certified with a

commercial third-party inspection company whose sole work is lightning protection, or is a UL Listed Lightning Protection Installer. In either case, the documentation must show that they have completed and passed the requirements for certification or listing, and have a minimum of 2 years documented experience installing lightning protection systems for DoD projects of similar scope and complexity.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Overall lightning protection system; G

Each major component; G

SD-06 Test Reports

Lightning Protection and Grounding System Test Plan; G

Lightning Protection and Grounding System Test; G

SD-07 Certificates

Lightning Protection System Installers Documentation; G

Component UL Listed and Labeled; G

Lightning protection system inspection certificate; G

Roof manufacturer's warranty; G

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" or "must" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

1.4.1 Installation Drawings

1.4.1.1 Overall System Drawing

Submit installation shop drawing for the overall lightning protection system. Include on the drawings the physical layout of the equipment (plan view and elevations), mounting details, relationship to other parts of the work, and wiring diagrams.

1.4.1.2 Major Components

Submit detail drawings for each major component including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

1.4.2 Component UL Listed and Labeled

Submit proof of compliance that components are UL Listed and Labeled. Listing alone in UL Electrical Construction, which is the UL Electrical Construction Directory, is not acceptable evidence. In lieu of Listed and Labeled, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

1.4.3 Lightning Protection and Grounding System Test Plan

Provide a lightning protection and grounding system test plan. Detail both the visual inspection and electrical testing of the system and components in the test plan. Identify (number) the system test points/locations along with a listing or description of the item to be tested and the type of test to be conducted. As a minimum, include a sketch of the facility and surrounding lightning protection system as part of the specific test plan for each structure. Include the requirements specified in paragraph, "Testing of Integral Lightning Protection System" in the test plan.

1.4.4 Lightning Protection System Inspection Certificate

Provide certification from a commercial third-party inspection company whose sole work is lightning protection, stating that the lightning protection system complies with NFPA 780. Third party inspection company cannot be the system installer or the system designer. Alternatively, provide a UL Lightning Protection Inspection Master Label Certificate for each facility indicating compliance to NFPA 780.

Inspection must cover every connection, air terminal, conductor, fastener, accessible grounding point and other components of the lightning protection system to ensure 100% system compliance. This includes witnessing the tests for the resistance measurements for ground rods with test wells, and for continuity measurements for bonds. It also includes verification of proper surge protective devices for power, data and telecommunication systems. Random sampling or partial inspection of a facility is not acceptable.

1.5 SITE CONDITIONS

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before changing the design.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings, such as tin or lead, or oversize conductors. Where a mechanical hazard is involved, increase conductor size to compensate for the hazard or protect conductors. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or

welds (including exothermic). All lightning protection components, such as bonding plates, air terminals, air terminal supports and braces, chimney bands, clips, connector fittings, and fasteners are to comply with the requirements of UL 96 classes as applicable.

2.1.1 Main and Bonding Conductors

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

2.2 COMPONENTS

2.2.1 Air Terminals

Provide solid air terminals with a blunt tip. Tubular air terminals are not permitted. Support air terminals more than 24 inches in length by suitable brace, supported at not less than one-half the height of the terminal.

2.2.2 Ground Rods

Provide ground rods made of copper-clad steel conforming to conform to UL 467. Provide ground rods that are not less than 3/4 inch in diameter and 10 feet in length. Do not mix ground rods of copper-clad steel or solid copper on the job.

2.2.3 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.4 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780 and UL 96.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

Provide a lightning protection system that meets the requirements of NFPA 780. Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, and grounding electrodes and ground ring electrode conductor. Expose conductors on the structures except where conductors are required to be in protective sleeves. Bond secondary conductors with grounded metallic parts within the building. Make interconnections within side-flash distances at or below the level of the grounded metallic parts.

3.1.1 Roof-Mounted Components

Coordinate with the roofing manufacturer and provide certification that the roof manufacturer's warranty is not violated by the installation methods for air terminals and roof conductors.

3.1.1.1 Air Terminals

In areas of snow or constant wind, ensure that a section of roofing material (minimum dimensional area of 1 square foot) is first glued to the roof and then the air terminal is glued to it unless the roof manufacturer recommends another solution. Use a standing seam base for installation of air terminals on a standing seam metal roof that does not produce any roof penetrations.

3.1.1.2 Roof Conductors

Use a standing seam base for installation of roof conductors on a standing seam metal roof that does not produce any roof penetrations.

3.1.2 Down Conductors

Protect exposed down conductors from physical damage as required by NFPA 780. Use Schedule 80 PVC to protect down conductors. Paint the Schedule 80 PVC to match the surrounding surface with paint that is approved for use on PVC.

3.1.3 Ground Connections

Attach each down conductor and ground ring electrode to ground rods by welding (including exothermic), brazing, or compression. All connections to ground rods below ground level must be by exothermic weld connection or with a high compression connection using a hydraulic or electric compression tool to provide the correct circumferential pressure. Accessible connections above ground level and in test wells can be accomplished by mechanical clamping.

3.1.4 Grounding Electrodes

Extend driven ground rods vertically into the existing undisturbed earth for a distance of not less 10 feet. Set ground rods not less than 3 feet nor more than 8 feet, from the structure foundation, and at least beyond the drip line for the facility. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE 81. Maximum allowed resistance of a driven ground rod is 25 ohms, under normally dry conditions. Contact the Contracting Officer for direction on how to proceed when two of any three ground rods, driven not less than 10 feet into the ground, a minimum of 10 feet apart, and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after having driven. For ground ring electrode, provide continuous No. 1/0 bare stranded copper cable. Lay ground ring electrode around the perimeter of the structure in a trench not less than 3 feet nor more than 8 feet from the nearest point of the structure foundation, and at least beyond the drip line for the facility. Install ground ring electrode to a minimum depth of 30 inches. Install a ground ring electrode in earth undisturbed by excavation, not earth fill, and do not locate beneath roof overhang, or wholly under paved areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the cable.

3.2 APPLICATIONS

3.2.1 Nonmetallic Exterior Walls with Metallic Roof

Bond metal roof sections together which are insulated from each other so

that they are electrically continuous, having a surface contact of at least 3 square inches.

3.3 INTERFACE WITH OTHER STRUCTURES

3.3.1 Fences

Bond metal fence and gate systems to the lightning protection system whenever the fence or gate is within 6 feet of any part of the lightning protection system in accordance with ANSI C2.

3.4 FIELD QUALITY CONTROL

3.4.1 Lightning Protection and Grounding System Test

Test the lightning protection and grounding system to ensure continuity is not in excess of 1 ohm and that resistance to ground is not in excess of 25 ohms. Provide documentation for the measured values at each test point. Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of test points, measured values for continuity and ground resistances, and soil conditions at the time that measurements were made. Submit results of each test to the Contracting Officer.

-- End of Section --

SECTION 26 42 13

GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM
05/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B3 (2013) Standard Specification for Soft or Annealed Copper Wire

ASTM B8 (2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1993; R 2016) Industrial Control and Systems: Enclosures

NEMA TC 2 (2020) Standard for Electrical Polyvinyl Chloride (PVC) Conduit

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

1.2 DEFINITIONS

It is convenient to classify corrosion by the forms in which it manifests itself, the basis for this classification being the appearance of the corroded metal. Each form can be identified by visual observation, although, in some cases, magnification is required. Valuable information for the solution of a corrosion problem can often be obtained through careful observation of the corroded test specimens or failed equipment. Examination before cleaning is particularly desirable. Cathodic Protection is a method used to control corrosion.

1.2.1 Cathodic Protection

Cathodic Protection (CP) is an electrochemical (half electrical and half chemical) method used to control corrosion of buried or submerged metallic structures. It prevents corrosion by making the protected structure a cathode by installing a more anodic metal (sacrificial or galvanic) anode or a metallic (impressed current) anode connected to a Direct Current (DC)

power source. When the proper amount of current is applied to the structure, it becomes a cathode. Since all corrosion occurs at the anode, the structure no longer corrodes. The electrons move in the metallic path (electrical). Reduction (chemical) reactions occur at the surface of the cathode resulting in a hydrogen coating and more alkaline environment. Oxidation (chemical) reactions occur at the surface of the anode resulting in corrosion and a more acidic environment. After a CP system is installed and adjusted to provide adequate protection, the hydrogen coats the defects in the coating and polarizes in the negative direction (to a copper/copper sulfate reference electrode) over time the current and potentials remain relatively stable; changes in currents or potentials indicate a problem. An error-free measurement of negative 850 millivolts DC or more negative to the copper/copper-sulfate reference electrode proves the structure is a cathode and corrosion has been mitigated.

1.2.2 Corrosion

It is convenient to classify corrosion by the forms in which it manifests itself, the basis for this classification being the appearance of the corroded metal. Each form can be identified by visual observation, although, in some cases, magnification is required. Valuable information for the solution of a corrosion problem can often be obtained through careful observation of the corroded test specimens or failed equipment. Examination before cleaning is particularly desirable. Some of the eight forms of corrosion are unique, but all of them are more or less interrelated.

The eight forms of corrosion are: (1) Uniform Attack, (2) Galvanic or Two-Metal Corrosion, (3) Crevice Corrosion, (4) Pitting Corrosion, (5) Intergranular Corrosion, (6) Selective Leaching, (7) Erosion Corrosion, and (8) Stress Corrosion Cracking. This listing is arbitrary but covers practically all corrosion failures and problems. The forms are not listed in any particular order of importance. Below, the eight forms of corrosion are discussed in terms of their characteristics, mechanisms, and preventive measures. Hydrogen damage, although not a form of corrosion, often occurs indirectly as a result of corrosive attack and is, therefore, included in this discussion.

1.2.3 Alternating Current (AC) Corrosion

AC corrosion occurs when there is a source of AC current, typically from a high voltage overhead AC (OHAC) power-line, when there is a low soil resistivity - typically less than 5,000 ohm-cm and there is a very small coating holidays. The AC corrosion pits typically have a tubercle of corrosion product at the pit. AC interference study modeling software can determine the mitigation solution to solve this problem. Typically, AC Corrosion mitigation is done in conjunction with high AC potentials and fault current mitigation.

1.2.4 AC Interference

AC interference occurs when a pipeline parallels a high-voltage overhead AC (OHAC) power-line. An interference study is required when this situation occurs as AC interference can cause high AC potentials along the pipeline (safety), can cause a fault condition between the pipeline and power-line and could cause AC corrosion to occur. The pipeline coating when exposed can have blisters/bubbles caused by the excessive AC. The interference study will use modeling software to determine what combination of interference may be occurring (if any) and provide the

mitigation solution to solve the problem.

1.2.5 Uniform Attack

Uniform attack is the most common form of corrosion. It is normally characterized by a chemical or electrochemical reaction that proceeds uniformly over the entire exposed surface or over a large area. The metal becomes thinner and eventually fails. For example, a piece of steel or zinc immersed in dilute sulfuric acid normally dissolves at a uniform rate over its entire surface. A sheet iron roof shows essentially the same degree of rusting over its entire outside surface.

Uniform attack, or general overall corrosion, represents the greatest destruction of metal on a tonnage basis. This form of corrosion, however, is not of great concern from a technical standpoint, because the life of equipment can be accurately estimated on the basis of comparatively simple tests. Merely immersing specimens in the fluid involved is often sufficient. Uniform attack can be prevented or reduced by (1) materials, such as coatings, that reduce contact between metal and electrolytes, (2) inhibitors, or (3) CP.

1.2.6 Galvanic or Two-Metal Corrosion

A potential difference usually exists between two dissimilar-metals when they are immersed in a corrosive or conductive solution. If these metals are placed in contact (or otherwise electrically connected), this potential difference produces electron flow between them. Corrosion of the less corrosion-resistant metal is usually increased, and attack of the more resistant material is decreased, compared to the behavior of these metals when they are not in contact. The less resistant metal becomes anodic and the more resistant metal becomes cathodic. Usually the cathode or cathodic metal corrodes very little or not at all in this type of couple. Because of the electric currents and dissimilar-metals involved, this form of corrosion is called galvanic, bi-metallic or two-metal, corrosion. Galvanic corrosion is restricted to electrochemical corrosion caused by dissimilar-metal effects. It is electrochemical corrosion, but this document must restrict the term galvanic to dissimilar-metal effects for purposes of clarity.

1.2.7 Crevice Corrosion

Intense localized corrosion frequently occurs within crevices and other shielded areas on metal surfaces exposed to corrosives. This type of attack is usually associated with small volumes of stagnant solution caused by holes, gasket surfaces, lap joints, surface deposits, and crevices under bolt and rivet heads. As a result, this form of corrosion is called crevice corrosion or, sometimes, deposit or gasket corrosion.

1.2.8 Pitting Corrosion

Pitting is a form of extremely localized attack that results in holes in the metal. These holes may be small or large in diameter, but in most cases they are relatively small. Pits are sometimes isolated or so close together that they look like a rough surface. Generally a pit may be described as a cavity or hole with the surface diameter about the same as or less than the depth. Pitting is one of the most destructive and insidious forms of corrosion. It causes equipment to fail because of perforation with only a small percent weight loss of the entire structure. It is often difficult to detect pits because of their small

size and because the pits are often covered with corrosion products. In addition, it is difficult to measure quantitatively and compare the extent of pitting because of the varying depths and numbers of pits that may occur under identical conditions. Pitting is also difficult to predict by laboratory tests. Sometimes the pits require a long time (several months or a year) to show up in actual service. Pitting is particularly vicious because it is a localized and intense form of corrosion, and failures often occur with extreme suddenness.

1.2.9 Intergranular Corrosion

Grain boundary effects are of little or no consequence in most applications or uses of metals. If a metal corrodes, uniform attack results since grain boundaries are usually only slightly more reactive than the matrix. However, under certain conditions, grain interfaces are very reactive and intergranular corrosion results. Localized attack at and adjacent to grain boundaries, with relatively little corrosion of the grains, is intergranular corrosion. The alloy disintegrates (grains fall out) or loses its strength. Intergranular corrosion can be caused by impurities at the grain boundaries, enrichment of one of the alloying elements, or depletion of one of these elements in the grain-boundary areas. Small amounts of iron in aluminum, wherein the solubility of iron is low, have been shown to segregate in the grain boundaries and cause intergranular corrosion. It has been shown that, based on surface tension considerations, the zinc content of a brass is higher at the grain boundaries. Depletion of chromium in the grain-boundary regions results in intergranular corrosion of stainless steels.

1.2.10 Selective Leaching

Selective leaching is the removal of one element from a solid alloy by corrosion processes. The most common example is the selective removal of zinc in brass alloys (dezincification). Similar processes occur in other alloy systems in which aluminum, iron, cobalt, chromium, and other elements are removed. Selective leaching is the general term to describe these processes, and its use precludes the creation of terms such as de-aluminumification, de-cobaltification. Parting is a metallurgical term that is sometimes applied, but selective leaching is preferred.

1.2.11 Erosion Corrosion

Erosion corrosion is the acceleration or increase in rate of deterioration or attack on a metal because of relative movement between a corrosive fluid and the metal surface. Generally, this movement is quite rapid, and mechanical wear effects or abrasion are involved. Metal is removed from the surface as dissolved ions, or it forms solid corrosion products, which are mechanically swept from the metal surface. Sometimes, movement of the environment decreases corrosion, particularly when localized attack occurs under stagnant conditions; this is not erosion corrosion because deterioration is not increased. Erosion corrosion is characterized in appearance by grooves, gullies, waves, rounded holes, and valleys and usually exhibits a directional pattern. In many cases, failures because of erosion corrosion occur in a relatively short time, and they are unexpected largely because evaluation corrosion tests were run under static conditions or because the erosion effects were not considered.

1.2.12 Stress-Corrosion Cracking

Stress-corrosion cracking refers to cracking caused by the simultaneous

presence of tensile stress and a specific corrosive medium. Many investigators have classified all cracking failures occurring in corrosive media as stress-corrosion cracking, including failures due to hydrogen embrittlement. However, these two types of cracking failures respond differently to environmental variables. To illustrate, CP is an effective method for preventing stress-corrosion cracking; however, hydrogen-embrittlement may be caused when excessive current is applied, especially on stainless steel. Hence, the importance of considering stress-corrosion cracking and hydrogen embrittlement as separate phenomena is obvious. During stress-corrosion cracking, the metal or alloy is virtually unattacked over most of its surface, while fine cracks progress through it. This cracking phenomenon has serious consequences, since it can occur at stresses within the range of typical design stress.

1.2.13 Exothermic Welding

Exothermic welding is used in CP to connect a copper wire to a metallic structure, usually steel or cast-iron. It is a pyrotechnic composition of copper oxide, aluminum powder and magnesium powder. The magnesium powder is ignited with a spark gun or electronic ignition equipment. The aluminum powder serves as fuel, and melts the copper oxide, which bonds the wire to the structure. Although not explosive, it can create brief bursts of heat and high temperature in a small area.

1.2.14 Error-Free

Potential measurement error due to a voltage drop caused by current flowing through a resistor (the electrolyte) between the reference electrode and the protected structure.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Anode junction boxes, bonding boxes, and test stations

SD-03 Product Data

Qualifications

Anode junction boxes, bonding boxes, and test stations

Permanent reference electrodes; G

Cable And Wire; G

SD-06 Test Reports

Tests and Measurements; G

SD-10 Operation and Maintenance Data

Cathodic Protection System; G

Cathodic Protection System, Data Package 5; G

SD-11, Closeout Submittals

Initial Cathodic Protection System Field Testing; G

Final Cathodic Protection System Field Test Report; G

1.4 QUALITY CONTROL

1.4.1 Regulatory Requirements

Obtain the services of a corrosion expert to supervise, inspect, and test the installation and performance of the cathodic protection system. The term "corrosion expert" refers to a person, who by thorough knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control of buried or submerged metallic structures.

1.4.2 Qualifications

The corrosion expert must be accredited or certified by NACE International, as a CP-4 CP Specialist or be a NACE International certified Corrosion Specialist or a registered professional engineer who has certification or licensing that includes education and experience in CP of the type of CP system being installed. The corrosion expert must have not less than three years of experience in the type of CP for buried or submerged metallic structures under this contract. Submit evidence of qualifications of the corrosion expert including their name and qualifications certified in writing to the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager prior to the start of construction. Certification must be submitted giving the name of the firm, the number of years of experience, and a list of not less than five of the firm's installations, three or more years old, that have been tested and found satisfactory.

1.4.3 Services of Corrosion Expert

The "corrosion expert" must make a minimum of three visits to the project site. The first of these visits will include obtaining soil resistivity data, acknowledging the type of pipeline coatings to be used and reporting to the contractor the type of CP required (GACP or ICCP). Once the submittals are approved and the materials delivered, the "corrosion expert" will revisit the site to verify the materials meet submittal requirements, ensure the contractor understands installation practices and that the contractor is capable and qualified to complete the installation.

The "corrosion expert" will be available (but not necessarily be onsite the entire time) during the installation of the CP system to answer questions, approve any changes or additions required during construction, or to provide recommendations as required. The third visit is to complete the training and demonstrations to applicable personnel on proper testing and maintenance techniques and to complete testing the installed CP systems to ensure it has been installed properly and meets adequate CP criteria. An additional visit is required if the One-Year-Warranty-Period-Testing is required.

1.5 WARRANTY

Provide equipment items that are supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design Requirements

2.1.1.1 Summary of Services Required

Include the following scope of services:

- a. Supply of CP system materials and equipment,
- b. Installation of CP system materials and equipment,
- c. System testing,
- d. Training,
- e. Operating and maintenance manual,

2.1.1.2 Location of Test Stations

Provide test stations of the type and location shown on drawings. Provide buried isolation joints with test wire connections brought to a test station. Reference all test stations with GPS coordinates.

2.1.2 Performance Requirements

The design must allow for synchronized interruption of all applied current.

2.1.2.1 Criteria of Cathodic Protection

The design must allow for interruption of all applied current.

- a. Determination of the on and polarized (instant off) potentials must be made with the protective current applied to the structure . Polarized potentials may be determined using a coupon test station (Error-Free (IR Free) test station). Polarized potentials must be determined by interrupting all the current being applied to the structure or coupon.
- b. The potential measurements for the native measurement and the polarized potential must be made with the reference electrode at the same exact location. The polarization decay measurements must also be made with the reference electrode at the same exact location as the polarization potential.
- c. The polarization decay measurements will be the difference between the polarized potential and a voltage measurement made after the interruption of protective current.

2.1.2.1.1 Steel

A negative polarized potential of 0.85 volts (850 millivolts) or more negative with respect to copper/copper sulfate reference cell (CSE) or more negative than 0.80 volts (800 millivolts) with respect to silver/silver chloride reference cell (SSC). The voltage must not be more negative than a negative polarized potential of 1.200 volts (1200 millivolts).

2.2 COMPONENTS

2.2.1 Test Stations

2.2.1.1 Flush Mounted

NEMA ICS 6. Metallic or non-metallic with terminal board, 5 terminal posts. A non-metallic enclosure must be molded of glass filled polycarbonate and urethane coated or Acrylonitrile Butadiene Styrene (ABS) plastic and mounted on a 18 inch length of PVC conduit. The unit must be of standard design, manufactured for use as a CP test station, complete with cover, terminal board, shunts, and brass or Type 304 stainless steel hardware. The terminal board must be removable for easy access to wires. Provide traffic valve box capable of withstanding loads indicated on Sheet SB001. The cover must have a cast in legend "CP TEST."

2.2.2 Terminal Boards

Provide terminal boards for anode junction boxes, bonding boxes, and test stations made of phenolic plastic 1/8 inch thick with dimensions as indicated. Insulated terminal boards must have the required number of terminals (one terminal required for each conductor). Install solderless copper lugs and copper buss bars, shunts, and variable resistors on the terminal board as indicated. Test station terminal connections will be permanently tagged to identify each termination of conductors (e.g. identify the conductors connected to the protected structure, anodes, reference electrodes and coupons).

2.3 MATERIALS

2.3.1 Galvanic Anodes

2.3.1.1 Dimensions and Weights

Bare anode weight as indicated in drawings not including core.

2.3.1.2 Aluminum Anodes

2.3.1.2.1 Anode Composition

Chemical composition as follows:

Zinc	2.80 - 6.50 percent maximum
Indium	0.010 - 0.02 percent maximum

Silicon	0.08 - 0.20 percent maximum
Copper	0.006 percent maximum
Iron	0.120 percent maximum
Cadmium	0.002 percent maximum
Other Each	0.02 percent maximum
Others Total	0.05 percent maximum
Aluminum	Remainder

2.3.1.2.2 Dimensions and Weights

Anode Weight as indicated on drawings not including core.

2.3.1.2.3 Anode Core

Iron pipe 3 inch diameter.

2.3.2 Wire and Cable

2.3.2.1 Test Wires

Test wires must be No. 12 AWG stranded copper wire with NFPA 70 Type Thermoplastic Wire (TW) or RHW or polyethylene insulation. Copper conductors conforming to ASTM B3 and ASTM B8.

2.3.2.2 Joint and Continuity Bond Cables

Provide a minimum of 3 inch fillet weld at the top of each interlock to mechanically bond piles in order to provided effective electrical bond. For pipe bearing piles provide bond wires as noted on drawings. .

2.3.3 Cable and wire Identification Tags

Laminated plastic material with black letters on a yellow background . Print letters and numbers a minimum of 3/16 inch in height. Provide identifier legend in accordance with the drawings .

2.3.4 Backfill Material

The backfill material must have the following composition, unless otherwise indicated:

Material	Approximate Percent by Weight
Gypsum	75
Bentonite	20

Material	Approximate Percent by Weight
Sodium Sulfate	5
Total	100

2.3.5 Permanent Reference Electrodes

Permanent reference electrodes must be silver silver-chloride specifically manufactured for submersible use. Must never need recharging, maintenance, or recalibration. Must have impregnated membrane which keeps electrode electrolytes from drying out or getting the reference electrode electrolyte contaminated. Must have ion trap to prevent reference electrode damage from hydrogen sulfide or excess chloride ions. Provide electrodes with No. 12 AWG, THHN cable of sufficient length to extend to the test station without splicing. Reference electrodes will have a minimum 20-year life, stability of plus or minus 5 millivolts under 3 microamp load. The manufacturer must calibrate the PRE to 316 mV plus or minus 10mV referenced to a standard hydrogen electrode (SHE) and provide a calibration certificate detailing the results of the calibration. Procedures for evaluating the accuracy annually must be included in the Operation and Maintenance Manual.

2.3.6 Coupons

Coupons must match the material of the structure, with 1 integrated connection(s) with electrical wire(s) and be designed, manufactured and procured for use as a corrosion coupon, IR-Free reference electrode, or AC reading electrode.

2.4 ACCESSORIES

2.4.1 Conduit

NEMA TC 2, Type EPC-40-PVC. Non-metallic conduit must conform to NEMA TC 2.

2.4.2 Exothermic Weld Kits

Exothermic weld kits specifically designed by the manufacturer for exothermic welding wires to metallic surfaces. Molds must be for specific type of metallic structure (steel, cast iron), specific diameter of pipe or metallic surface and specific size (AWG) and type of wire (solid, stranded).

2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

2.5.1 Non-Destructive Testing of Anodes

Contractor must perform the tests in the presence of the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. One anode of each type will be chosen at random for non-destructive testing and will be submerged in a container of fresh water for about 30 minutes. Contractor must then measure the anode-to-water potential difference between a calibrated copper/copper sulfate reference electrode. Potential differences must generally be within the following ranges:

Anode Type	DC Volts to Calibrated Cu/CuSO ₄ Reference Electrode
Aluminum	More Negative than Negative 1.0 Volts DC

Failure of the test anode to conform to this specification can be cause for rejecting all anodes from the same lot as the test anode. The contractor must mark all rejected anodes on the ends with a 6 inch high "X" using yellow spray paint. Failed anodes must be removed from the job site by the end of the day. The contractor must replace any rejected anodes at the contractor's expense. The destructive testing provision must also apply to replacement anodes as well.

PART 3 EXECUTION

3.1 SAFETY PRECAUTIONS AND HAZARDOUS LOCATIONS

Any personnel performing operations that will generate heat, sparks, or flame in hazardous locations must first perform adequate safety precautions. A trained responsible person must ensure the area is safe to perform the operation. Required actions include ensuring adequate ventilation before work starts, air monitoring, and a fire watch must be provided and remain for 30 minutes after the operation is completed. A minimum of 20 pound ABC type fire extinguisher must be available and must be inspected before each use. Equipment being used must be inspected and used in accordance with manufacturer recommendations. Combustibles that are in the work area(s) must be moved or if they cannot be moved, be covered with fire retardant welding blankets. When performing exothermic welding, properly sized charges and inspection of the structure condition must be accomplished to ensure a safe operation.

3.2 INSTALLATION

3.3 ANODES AND LEAD WIRE

3.3.1 Anode Installation

Unless otherwise authorized, installation must not proceed without the presence of the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. Anodes of the size specified must be installed to the depth indicated and at the locations shown. Locations may be changed to clear obstructions with the approval of the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. Anodes will be installed in sufficient number and of the required type, size, and spacing to obtain a uniform current distribution over the surface of the structure. The anode system will be designed for a life of 25 years of continuous operation.

3.4 FIELD QUALITY CONTROL

Field tests must be witnessed by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager or their designated representative. Advise the Contracting Officer or Contracting Officer's Representative 5 days prior to performing each field test. Quality control for the cathodic protection system must consist of the following:

- a. Initial field testing by the contractor upon construction.

- b. Government Field Testing after contractor initial field test report submission.
- c. Warranty period field testing by the contractor.
- d. Final field testing by the contractor after one year of service.

3.4.1 Tests and Measurements

3.4.1.1 Native Potentials

Notify the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager a minimum of five (5) working days prior to each test. Native potential measurements should be taken after installation of piles but prior to installation of the anodes.

3.4.1.2 Protected Potentials

Systems must be tested and inspected by the contractor's corrosion engineer in the presence of the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager corrosion protection engineer or an approved representative. Notify the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager a minimum of five working days prior to each test. At least 24 hours after native potential testing and connection of anodes to the structure, measure protected structure-to-electrolyte potentials. The locations of these measurements must be identical to the locations specified for native potential measurements. Use the same measuring equipment that is specified for measuring protected potential measurements. Record test data, including date, time, and locations of testing and submit report to the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. Contractor must correct and retest, at the contractor's and Technical Expert's expense, deficiencies in the materials and installation observed by these tests and inspections.

3.4.1.3 Reference Electrode Potential Measurements

Upon completion of the installation and with the entire CP system in operation, electrode potential measurements must be made using a copper/copper sulfate reference electrode and a potentiometer-voltmeter, or a direct-current voltmeter having an internal resistance (sensitivity) of not less than 10 megohms per volt and a full scale of 10 volts. The locations of these measurements must be identical to the locations used for baseline potentials. The values obtained and the date, time, and locations of measurements must be recorded. No less than eight (8) measurements will be made over any length of line or component. Additional measurements will be made at each distribution service riser, with the reference electrode placed directly over the service line.

3.4.1.4 Initial Cathodic Protection System Field Testing

Initial field testing must be completed by the contractor upon completion of construction. Field testing must be witnessed by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager or their designated representative. Advise the Contracting Officer or Contracting Officer's Representative 5 days prior to performing each field test. Field testing must include native and protected potentials, and anode current testing.

The contractor must submit an initial field test report of the cathodic protection system. All structure-to-electrolyte measurements, including initial potentials, and other required testing must be recorded on applicable forms. Identification of test locations, test station and anode test stations will coordinate with the as-built drawings and be provided on system drawings included in the report. The contractor must locate, correct, and report to the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager any short circuits encountered during the checkout of the installed CP system.

3.4.1.5 Government Field Testing

The government corrosion engineer must review the contractor's initial field testing report. Approximately four weeks after receipt of the contractor's initial test report, the system will be tested and inspected in the contractor's presence by the government corrosion engineer. The contractor must correct, at the contractor's expense, materials and installations observed by these tests and inspections to not be in conformance with the plans and specifications. The contractor will pay for all retesting done by the government engineer made necessary by the correction of deficiencies.

3.4.1.6 Final Acceptance Field Testing

Conduct final field testing of the cathodic protection system utilizing the same procedures specified under, "Initial Field Testing of the Galvanic Cathodic Protection Systems". The contractor will inspect, test, and adjust the cathodic protection system after one year of operation to ensure its continued conformance with the criteria outlined below. The performance period for these tests will commence upon preliminary acceptance for the cathodic protection system by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. Copies of the Final Cathodic Protection System Field Test Report, certified by the contractor's corrosion engineer must be submitted to the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager and the geographic EFD corrosion engineer for approval, and as an attachment to the operation and maintenance manual in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. The government corrosion engineer must review the contractor's final field testing report.

3.5 CLOSEOUT ACTIVITIES

3.5.1 Training

3.5.1.1 Instruction to Government Personnel

During the warranty testing or at a time designated by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager, make available the services of a technician regularly employed or authorized by the manufacturer of the Cathodic Protection System for instructing government personnel in the proper operation, maintenance, safety, and emergency procedures of the Cathodic Protection System. The period of instruction must be not less than two hours and not more than two 8-hour working days. Conduct the training at the jobsite or at another location mutually satisfactory to the government and the contractor. The field instructions will cover all of the items contained in the operation and maintenance manual.

-- End of Section --

SECTION 26 51 00

INTERIOR LIGHTING

05/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A580/A580M	(2018) Standard Specification for Stainless Steel Wire
ASTM A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM B164	(2003; R 2014) Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM D4674 REV A	(2002; R 2010) Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments

EUROPEAN UNION (EU)

Directive 2011/65/EU	(2011) Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment
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ILLUMINATING ENGINEERING SOCIETY (IES)

IES HB-10	(2011; Errata 2015) IES Lighting Handbook
IES LM-79	(2008) Electrical and Photometric Measurements of Solid-State Lighting Products
IES LM-80	(2019) Measuring Lumen Maintenance of LED Light Sources
IES RP-16	(2017) Nomenclature and Definitions for Illuminating Engineering
IES TM-15	(2011) Luminaire Classification System for Outdoor Luminaires
IES TM-21	(2019) Projecting Long Term Lumen Maintenance of LED Light Sources
IES TM-30	(2018) IES Method for Evaluating Light Source Color Rendition

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative
Dictionary of IEEE Standards Terms

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

IEEE C62.41 (1991; R 1995) Recommended Practice on
Surge Voltages in Low-Voltage AC Power
Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 77 (2017) Temporal Light Artifacts: Test
Methods and Guidance for Acceptance
Criteria

NEMA 250 (2018) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NEMA ANSLG C78.377 (2017) Electric Lamps— Specifications for
the Chromaticity of Solid State Lighting
Products

NEMA C82.77-10 (2020) Harmonic Emission Limits - Related
Power Quality Requirements

NEMA SSL 1 (2016) Electronic Drivers for LED Devices,
Arrays, or Systems

NEMA SSL 3 (2011) High-Power White LED Binning for
General Illumination

NEMA SSL 7A (2015) Phase-Cut Dimming for Solid State
Lighting: Basic Compatibility

NEMA WD 1 (1999; R 2015) Standard for General Color
Requirements for Wiring Devices

NEMA WD 7 (2011; R 2016) Occupancy Motion Sensors
Standard

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 101 (2021) Life Safety Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15 Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 20 (2010; Reprint Feb 2012) General-Use Snap
Switches

UL 94	(2013; Reprint Jun 2020) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 508	(2018) UL Standard for Safety Industrial Control Equipment
UL 916	(2015) Standard for Energy Management Equipment
UL 924	(2016; Reprint May 2020) UL Standard for Safety Emergency Lighting and Power Equipment
UL 1472	(2015) UL Standard for Safety Solid-State Dimming Controls
UL 1598	(2021; Reprint Jun 2021) Luminaires
UL 2043	(2013) Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
UL 8750	(2015; Reprint Sep 2020) UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.2 RELATED REQUIREMENTS

Materials not considered to be luminaires, luminaire accessories, or lighting equipment are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Luminaires and accessories that are mounted in exterior environments and not attached to the exterior of the building are specified in Section 26 56 00 EXTERIOR LIGHTING. Cybersecurity requirements are specified in Section 25 05 11.01. CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS. Commissioning requirements for Army and Air Force projects are specified in Section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING. Commissioning requirements for Navy projects are specified in Section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING.

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications and on the drawings, must be as defined in IEEE 100 and IES RP-16.
- b. For LED luminaire light sources, "Useful Life" is the operating hours before reaching 70 percent of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions. This is also known as 70 percent "Rated Lumen Maintenance Life" as defined in IES LM-80.
- c. For LED luminaires, "Luminaire Efficacy" (LE) is the appropriate measure of energy efficiency, measured in lumens/watt. This is gathered from LM-79 data for the luminaire, in which absolute photometry is used to measure the lumen output of the luminaire as one

entity, not the source separately and then the source and housing together.

- d. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Luminaire Drawings; G

Occupancy/Vacancy Sensor Coverage Layout; G; S

Lighting Control System One-Line Diagram; G

Sequence of Operation for Lighting Control System; G

SD-03 Product Data

Luminaires; G

Light Sources; G

LED Drivers; G

Luminaire Warranty; G

Lighting Controls Warranty; G

Local Area Controller; G

Lighting Control Panel; G

Switches; G

Wall Box Dimmers; G

Occupancy/Vacancy Sensors; G

Photosensors; G

Power Packs; G

Power Hook Luminaire Hangers; G

Exit Signs; G

Emergency Drivers; G

SD-06 Test Reports

IES LM-79 Test Report

IES LM-80 Test Report

IES TM-21 Test Report

IES TM-30 Test Report

Occupancy/Vacancy Sensor Verification Test

Photosensor Verification Test

SD-07 Certificates

LED Driver and Dimming Switch Compatibility Certificate

SD-10 Operation and Maintenance Data

Lighting System, Data Package 5

Lighting Control System, Data Package 5

Maintenance Staff Training Plan

End-User Training Plan

1.5 QUALITY ASSURANCE

Data, drawings, and reports must employ the terminology, classifications and methods prescribed by the IES HB-10 as applicable, for the lighting system specified.

1.5.1 Luminaire Drawings

Include dimensions, accessories installation details, and construction details. Photometric data, including CRI, CCT, LED driver type, aiming diagram, zonal lumen data, and candlepower distribution data must accompany shop drawings.

1.5.2 IES LM-79 Test Report

Submit test report on manufacturer's standard production model of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data in IES format as outlined under "14.0 Test Report" in IES LM-79.

1.5.3 IES LM-80 Test Report

Submit report on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data as outlined under "8.0 Test Report" in IES LM-80.

1.5.4 IES TM-21 Test Report

Submit test report on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data, as well as required interpolation information as outlined under "7.0 Report" in IES TM-21.

1.5.5 IES TM-30 Test Report

Submit color vector graphic in accordance with IES TM-30 on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Include spectral distribution of test LED light source.

1.5.6 LED Driver and Dimming Switch Compatibility Certificate

Submit certification from the luminaire, driver, or dimmer switch manufacturer that ensures compatibility and operability between devices without flickering and to specified dimming levels.

1.5.7 Occupancy/Vacancy Sensor Coverage Layout

Provide floor plans showing coverage layouts of all devices using manufacturer's product information.

1.5.8 Test Laboratories

Test laboratories for the IES LM-79 and IES LM-80 test reports must be one of the following:

- a. National Voluntary Laboratory Accreditation Program (NVLAP) accredited for solid-state lighting testing as part of the Energy-Efficient Lighting Products laboratory accreditation program for both LM-79 and LM-80 testing.
- b. One of the qualified labs listed on the Department of Energy - LED Lighting Facts Approved Testing Laboratories List for LM-79 testing.
- c. One of the EPA-Recognized Laboratories listed for LM-80 testing.

1.5.9 Regulatory Requirements

Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70, unless more stringent requirements are specified or indicated. Provide luminaires and assembled components that are approved by and bear the label of UL for the applicable location and conditions unless otherwise specified.

1.5.10 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products must have been in satisfactory commercial or industrial use for six months prior to bid opening. The six-month period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the six-month period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.10.1 Alternative Qualifications

Products having less than a six-month field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.10.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than six months prior to date of delivery to site, unless specified otherwise.

1.6 WARRANTY

Support all equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.1 Luminaire Warranty

Provide and transfer to the government the original LED luminaire manufacturers standard commercial warranty for each different luminaire manufacturer used in the project.

- a. Provide a written five year minimum replacement warranty for material, luminaire finish, and workmanship. Provide written warranty document that contains all warranty processing information needed, including customer service point of contact, whether or not a return authorization number is required, return shipping information, and closest return location to the luminaire location.

- (1) Finish warranty must include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

- (2) Material warranty must include:

- (a) All LED drivers and integral control equipment.

- (b) Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective, non-starting, or operating below 70 percent of specified lumen output.

- b. Warranty period must begin in accordance with the manufacturer's standard warranty starting date.

- c. Provide replacements that are promptly shipped, without charge, to the using Government facility point of contact and that are identical to or an improvement upon the original equipment. All replacements must include testing of new components and assembly.

1.6.2 Lighting Controls Warranty

Provide and transfer to the government the original lighting controls manufacturers standard commercial warranty for each different lighting controls manufacturer used in the project. Warranty coverage must begin from date of final system commissioning or three months from date of delivery, whichever is the earliest. Warranty service must be performed by a factory-trained engineer or technician.

- a. Unless otherwise noted, provide a written five year minimum warranty on the complete system for all systems with factory commissioning. Provide warranty that covers 100 percent of the cost of any replacement parts and services required over the five years which are directly attributable to the product failure. Failures include, but are not limited to, the following:
 - (1) Software: Failure of input/output to execute switching or dimming commands.
 - (2) Damage of electronic components due to transient voltage surges.
 - (3) Failure of control devices, including but not limited to occupancy sensors, photosensors, and manual wall station control devices.
- b. Provide a written five year minimum warranty on all input devices against defect in workmanship or materials provided by device manufacturer.
- c. Provide a written five year minimum warranty on all control components attached to luminaires against defect in workmanship or materials.

1.7 OPERATION AND MAINTENANCE MANUALS

1.7.1 Lighting System

Provide operation and maintenance manuals for the lighting system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the lighting system for the building. Additional requirements for the Navy are provided in Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Include the following:

- a. Manufacturers' operating and maintenance manuals.
- b. Luminaire shop drawings for modified and custom luminaires.
- c. Luminaire Manufacturers' standard commercial warranty information as specified in paragraph LUMINAIRE WARRANTY.

1.7.2 Lighting Control System

Provide operation and maintenance manuals for the lighting control system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the lighting control system for the building. Include the following:

- a. Lighting control system layout and wiring plan.
- b. Lighting control system one-line diagram.
- c. Product data for all devices, including installation and programming instructions.
- d. Occupancy/vacancy sensor coverage layout.
- e. Training materials, such as videos or in-depth manuals, that cover basic operation of the lighting control system and instructions on

modifying the lighting control system. Training materials must include calibration, adjustment, troubleshooting, maintenance, repair, and replacement.

- f. Sequence of operation descriptions for each typical room type, including final programming, schedules, and calibration settings.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

2.2 LUMINAIRES

UL 1598, NEMA C82.77-10. Provide luminaires as indicated in the luminaire schedule and NL plates or details on project plans, complete with light source, wattage, and lumen output indicated. All luminaires of the same type must be provided by the same manufacturer. Luminaires must be specifically designed for use with the driver and light source provided.

2.2.1 Luminaires

UL 8750, IES LM-79, IES LM-80. For all luminaires, provide:

- a. Complete system with LED drivers and light sources.
- b. Housings constructed of non-corrosive materials. All new aluminum housings must be anodized or powder-coated. All new steel housings must be treated to be corrosion resistant.
- c. IES TM-21, IES LM-80. Minimum L70 lumen maintenance value of 50,000 hours unless otherwise indicated in the luminaire schedule. Luminaire drive current value must be identical to that provided by test data for luminaire in question.
- d. Minimum efficacy as specified in the luminaire schedule. Theoretical models of initial lamp lumens per watt are not acceptable. If efficacy values are not listed in the luminaire schedule, provide luminaires that meet the following minimum values:

Luminaire Style	Minimum Luminaire Efficacy
Recessed 1 by 4, and 2 by 2	100 LPW
Recessed Downlight (fixed, adjustable, wallwash)	80 LPW
Linear, Accent (undercabinet, cove)	45 LPW
Linear, Ambient (indirect wall mount, linear pendent)	100 LPW
High Bay, Low Bay, and Industrial Locations	100 LPW

Luminaire Style	Minimum Luminaire Efficacy
Exterior Wall Sconce	50 LPW

- e. UL listed for dry or damp location typical of interior installations. Any luminaire mounted on the exterior of the building must be UL listed for wet location typical of exterior installations.
- f. LED driver and light source package, array, or module are accessible for service or replacement without removal or destruction of luminaire.
- g. Lenses constructed of heat tempered borosilicate glass, UV-resistant acrylic, or silicone. Sandblasting, etching and polishing must be performed as indicated in the luminaire description.
- h. IES TM-15. Provide exterior building-mounted luminaires that do not exceed the BUG ratings as listed in the luminaire schedule. If BUG ratings are not listed in the luminaire schedule, provide luminaires that meet the following minimum values for each application and mounting conditions:

Lighting Application	Mounting Conditions	BUG Rating
Exterior Wall Sconce	Above 4 feet AFF	B1-U0-G2

2.3 LIGHT SOURCES

NEMA ANSLG C78.377, NEMA SSL 3. Provide type, delivered lumen output, and wattage as indicated in the luminaire schedule on project plans.

2.3.1 LED Light Sources

CEC Title 20. Provide LED light sources that meet the following requirements:

- a. NEMA ANSLG C78.377. Emit white light and have a nominal CCT of 4000 Kelvin.
- b. Minimum Color Rendering Index (CRI) of 90.
- c. Light source color consistency by utilizing a binning tolerance within a 3-step McAdam ellipse.

2.4 LED DRIVERS

NEMA SSL 1, UL 8750. Provide LED drivers that are electronic, UL Class 1 or Class 2, constant-current type and that comply with the following requirements:

- a. The combined driver and LED light source system does not exceed the minimum luminaire efficacy values as listed in the luminaire schedule provided.
- b. Operates at a voltage of 120-277 volts at 50/60 hertz, with input voltage fluctuations of plus/minus 10 percent.
- c. Power Factor (PF) greater than or equal to 0.90 at full input power and across specified dimming range.
- d. Maximum Total Harmonic Distortion (THD) less than 20 percent at full input power and across specified dimming range.
- e. Operates for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.
- f. Withstands Category A surges of 4 kV without impairment of performance. Provide surge protection that is integral to the driver.
- g. Integral thermal protection that reduces the output power to protect the driver and light source from damage if the case temperature approaches or exceeds the driver's maximum operating temperature.
- h. 47 CFR 15. Complies with the requirements of the Federal Communications Commission (FCC) rules and regulations, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
- i. Class A sound rating.
- j. Provide dimming capability as indicated in the luminaire schedule on project plans. Dimmable drivers must dim down to 10 percent. Dimmable drivers must be controlled by a Class 2 low voltage 0-10VDC controller dimming signal protocol unless otherwise specified. LED drivers of the same family/series must track evenly across multiple luminaires at all light levels.

2.5 LIGHTING CONTROLS

Provide network certification for all networked lighting control systems and devices in accordance with the requirements of Section 25 05 11.01. CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS. Provide lighting control systems that do not switch off battery-operated or emergency backup luminaires or exit signs in path of egress. Provide system with override of lighting control devices controlling luminaires in path of egress with activation of fire alarm system.

2.5.1 System

Provide lighting control system that operates the lighting system as described in the lighting control strategies in the project plans. Submit Sequence of Operation for Lighting Control System describing the operation of the proposed lighting control system and devices. Sequence of Operation must provide the strategies identified in the lighting control

strategies.

2.5.1.1 Localized Control Systems

Provide room or area-wide lighting control system capable of manual control, time-based control, and receiving input from photosensors and occupancy/vacancy sensors.

2.5.1.1.1 Local Area Controller

Provide controller designed for single area or room with the following requirements:

- a. Operates at a voltage of 277 volts at 50/60 hertz.
- b. 2 zone, with 2 relays rated 20 amps with one manual switchdimmer per zone.
- c. Provide inputs for occupancy/vacancy sensors, photosensors, and low-voltage wall switches.
- d. Provide daylight harvesting capability with full-range dimming control with input from photosensor.
- e. Provide full 'OFF' function with input from external time clock input.
- f. Capable of 0-10V dimming.
- g. AV interface via ethernet and CAT5.
- h. Provide override 'ON' function with input from Fire Alarm Control Panel for all emergency lighting. Controller must not turn off power to emergency batteries or exit signs.

2.5.1.2 Centralized Control Systems

Provide a centralized lighting control system capable of manual control, time-based control, receiving input from photosensors and occupancy/vacancy sensors, with the capabilities of controlling, monitoring, and programming changes from one centralized on-site location, and integration with other building systems.

2.5.1.2.1 Lighting Control Panel

UL 916, 47 CFR 15. Provide an electronic, programmable lighting control panel complete with microprocessor, capable of providing lighting control with input from internal programming, digital switches, time clocks, and other control devices.

Enclose panel hardware in a surface-mounted, NEMA 1, painted, steel enclosure with lockable access door and ventilation openings. Internal low-voltage compartment must be separated from line-voltage compartment of enclosure with only low-voltage compartment accessible upon opening of door. Provide additional remote cabinets that communicate back to main control panel as required. Provide Lighting Control Panels that meet the following criteria:

- a. Input voltage of 120-277 at 50/60 Hz, with internal low-voltage VDC power supply as required.

- b. Solid-state, microprocessor-based, internal astronomical time clock. Microprocessor must have nonvolatile memory and must reset automatically after power interruptions of up to 90 days.
- c. Interface for providing local programming and control capability, with physical key-locked cover or programmed security access code to prevent unauthorized use.
- d. Dimming modules capable of 0-10V dimming.
- e. Modules and control panels include multichannel output with 8 channels, with multiple inputs for manual control, photosensors, and occupancy/vacancy sensors.
- f. Control processor is configured to interface with BACnet in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.
- g. Outputs that require line-voltage switching are provided by relays which are designed for 10 years of use at full rated load.
- h. Control processor indicates failure of normal power and which circuits are supplied by alternative power source if connected to emergency lighting units.

2.5.2 Devices

2.5.2.1 Switches

Provide line-voltage toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. When used for non-digital loads, devices must be rated at 20 Amps inductive load, and be compatible with the lighting control systems.

2.5.2.2 Wall Box Dimmers

UL 1472, UL 20, IEEE C62.41, NEMA 77, NEMA SSL 7A. Dimmers must provide flicker-free, continuously variable light output throughout the dimming range of 10 percent to 100 percent. Devices must be capable of operating at their full rated capacity regardless of being single or ganged-mounted, and be compatible with three-way and four-way switching scenarios.

Provide wall-box dimmers that meet the following requirements:

- a. Device operates as part of a lighting control system.
- b. Device operates with the use of a vertical slider, paddle, rotary, button, or toggle with adjacent vertical slider.
- c. Finish of device matches switches and outlets in the same area.
- d. Back box in wall has sufficient depth to accommodate body of switch and wiring.
- e. Dimmer is capable of controlling 0-10 volt LED drivers. Dimmers and the drivers they control must be provided from the same manufacturer or tested and certified as compatible for use together.

- f. Radio frequency interference suppression is integral to device.

2.5.2.3 Occupancy/Vacancy Sensors

IEEE C62.41, NEMA WD 1, UL 94, UL 916, UL 508, ASTM D4674 REV A, NEMA WD 7. Provide occupancy/vacancy sensors with coverage patterns as indicated on project plans. Provide no less quantity of sensors as shown on plans, but add additional sensors when required to fulfill coverage requirement for the specific model of sensor provided. Provide sensor types as described in the sequence of operations. Sensor locations and quantities are shown in shop drawings provided by the lighting control system manufacturer. Provide occupancy sensor operation that requires movement to activate luminaires controlled and turns luminaires off after a set time of inactivity. Provide vacancy sensor operation that requires manual control to activate luminaires and turns luminaires off after a set time of inactivity. Provide ceiling or wall-mounted occupancy/vacancy sensors that meet the following requirements:

- a. Operating voltage of 277 volts.
- b. Time delay of 30 seconds to 30 minutes with at least four intermediate time delay settings.
- c. Sensors are ceiling mounted wall mounted integral to luminaire.
- d. No minimum load requirement and be capable of switching from zero to 800 W at 120 VAC, 50/60 Hz and from zero to 1200 W at 277 VAC, 50/60 Hz.
- e. Shielded or controlled by internal logic to adjust sensitivity to avoid false triggering due to ambient temperature, air temperature variations or HVAC air movement.
- f. Sensor is equipped to automatically energize the connected load upon loss of normal power when located in a means of egress.
- g. Occupancy and vacancy operation is field-adjustable and programmable via lighting control system processor.
- h. No leakage current to load when in the off mode.
- i. Utilize zero-crossing circuitry to prevent damage from high inrush current and to promote long life operation.
- j. Allow the adding or deleting of specific luminaires or zones to the assigned sensor without the use of ladders.

2.5.2.3.1 Dual Technology Sensors

Provide dual technology sensors that meet the requirements for PIR sensors and ultrasonic sensors indicated above. If either the PIR or ultrasonic sensing registers occupancy, the luminaires must remain on.

2.5.2.3.2 High Bay Sensors

Provide occupancy/vacancy sensors specifically designed for high-bay mounting applications for all sensors integral to luminaires mounted above 35 feet using PIR technology. Provide high-bay sensors with interchangeable lenses for 360 degree open area coverage or narrow

rectangular warehouse aisle coverage. Provide sensors that are designed to mount directly to or adjacent to high- or low-bay luminaires.

2.5.2.3.3 Power Packs

UL 2043. Provide power packs to provide power to lighting control sensors as required in accordance with the manufacturer's specifications. Provide power packs that meet the following requirements:

- a. Operate at an input voltage of 120-277 VAC, with an output voltage 24 VDC at 225 mA.
- b. Constructed of plenum-rated, high-impact thermoplastic enclosure.
- c. Utilizes zero-crossing circuitry to prevent damage from inrush current.
- d. Maximum load rating of 16 amps for electronic lighting loads.
- e. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

2.5.2.4 Photosensors

Provide photosensors that meet the following requirements:

- a. Detect changes in ambient lighting level and enable dimming as required by sequence of operation by operating in an open-loop system.
- b. Contain a detection cone, where the base of the cone may be circular or an elongated shape, and where the smallest angle between the edge and the axis of the cone is between 20 and 50 degrees. The cone axis may be tilted to the vertical when installed to give the sensor preferred directionality.
- c. Sensors are ceiling-mounted with sensitivity, filtering, range and viewing angle to meet requirements of sequence of operation, scope of work and construction documents.
- d. Time delay that is adjustable from 1 to 30 seconds ON delay, and 1 to 30 minutes OFF delay to prevent cycling, with deadband adjustment of 25 percent to 100 percent above lower setpoint.
- e. Output dimming signal is linear to light level with less than 1 percent variation. Cadmium sulfide photo-resistors are not acceptable.
- f. Sensor is not combined in the same housing or location with occupancy or vacancy sensors if the proper location for one function compromises the successful operation of the other function, or in any way reduces the system's ability to meet the design intent.

2.6 EXIT AND EMERGENCY LIGHTING EQUIPMENT

2.6.1 Exit Signs

UL 924, NFPA 101. Provide wattage as indicated in the luminaire schedule on project plans. Provide LED Exit Signs that meet the following criteria:

- a. Housing constructed of UV-stable, thermo-plastic.

- b. UL listed for dampwet location.
- c. Configured for universal mounting.
- d. 6 inch high, 3/4 inch stroke red lettering on face of sign with chevrons on either side of lettering to indicate direction.
- e. Single or double face as indicated in project plans and luminaire schedule.

2.6.1.1 Exit Signs with Battery Backup

Equip with automatic power failure device, test switch, and pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery must be sealed, maintenance free nickel-cadmium type, and must operate unattended for a period of not less than five years. Emergency run time must be a minimum of 1-1/2 hours. LEDs must have a minimum rated life of 10 years.

2.6.2 Emergency Lighting Unit (ELU)

UL 924, NFPA 101. Provide emergency lighting units (ELUs) completely assembled with wiring and mounting devices, ready for installation at the locations indicated. Provide in UV-stable, thermo-plastic housing with UL damp label UL wet label as indicated. Emergency lighting units must be rated for 12 volts, except units having no remote-mounted light sources and having no more than two unit-mounted light sources may be rated six volts. Equip units with brown-out sensitive circuit to activate battery when input voltage falls to 75 percent of normal. Equip with two LED light sources, automatic power failure device, test switch, and pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery must be sealed, maintenance free nickel-cadmium type, and must operate unattended for a period of not less than five years. Emergency run time must be a minimum of 90 minutes. LEDs must have a minimum rated life of 10 years.

2.6.3 LED Emergency Drivers

UL 924, NFPA 101. Provide LED emergency driver with automatic power failure detection, test switch and LED indicator (or combination switch/indicator) located on luminaire exterior, and fully-automatic solid-state charger, battery and inverter integral to a self-contained housing. Provide self-diagnostic function integral to emergency driver.

2.6.4 Self-Diagnostic Circuitry for LED Drivers

UL 924, NFPA 101. Provide emergency lighting unit with fully-automatic, integral self-testing/diagnostic electronic circuitry. Circuitry must provide for a one minute diagnostic test every 28 days, and a 30 minute diagnostic test every six months, minimum. Any malfunction of the unit must be indicated by LED(s) visible from the exterior of the luminaire. A manual test switch must also be provided to perform a diagnostic test at any given time.

2.7 LUMINAIRE MOUNTING ACCESSORIES

2.7.1 Suspended Luminaires

- a. Provide hangers capable of supporting twice the combined weight of

luminaires supported by hangers.

- b. Hangers must allow luminaires to swing within an angle of 45 degrees. Brace pendants 4 feet or longer to limit swinging. Provide with swivel hangers to ensure a plumb installation for rigid stem pendants. Provide cadmium-plated steel with a swivel-ball tapped for the conduit size indicated.
- c. Single-unit suspended luminaires must have cable hangers. Multiple-unit or continuous row luminaires with a separate power supply cord must have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end.
- d. Provide all linear pendant and surface mounted luminaires with two supports per four-foot section or three per eight-foot section unless otherwise recommended by manufacturer.

2.7.2 Recess and Surface Mounted Luminaires

Provide access to light source and LED driver from bottom of luminaire. Provide trim and lenses for the exposed surface of flush-mounted luminaires as indicated on project drawings and specifications. Luminaires recessed in ceilings which have a fire resistive rating of one hour or more must be enclosed in a box which has a fire resistive rating equal to that of the ceiling. For surface mounted luminaires with brackets, provide flanged metal stem attached to outlet box, with threaded end suitable for supporting the luminaire rigidly in design position. Flanged part of luminaire stud must be of broad base type, secured to outlet box at not fewer than three points.

2.7.3 Luminaire Support Hardware

2.7.3.1 Wire

ASTM A641/A641M. Galvanized, soft tempered steel, minimum 0.11 inches in diameter, or galvanized, braided steel, minimum 0.08 inches in diameter.

2.7.3.2 Wire for Humid Spaces

ASTM A580/A580M. Composition 302 or 304, annealed stainless steel, minimum 0.11 inches in diameter.

ASTM B164. UNS NO4400, annealed nickel-copper alloy, minimum 0.11 inches in diameter.

2.7.3.3 Threaded Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

2.7.4 Power Hook Luminaire Hangers

UL 1598. Provide an assembly consisting of through-wired power hook housing, interlocking plug and receptacle, power cord, and luminaire support loop. Power hook housing must be cast aluminum having two 3/4 inch threaded hubs. Support hook must have safety screw. Luminaire support loop must be cast aluminum with provisions for accepting 3/4 inch threaded stems. Power cord must include 16 inches of 3 conductor No. 16 Type SO cord. Assembly must be rated 120 volts or 277 volts, 15 amperes.

2.8 EQUIPMENT IDENTIFICATION

2.8.1 Manufacturer's Nameplate

Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8.2 Labels

UL 1598. All luminaires must be clearly marked for operation of specific light sources and LED drivers. The labels must be easy to read when standing next to the equipment, and durable to match the life of the equipment to which they are attached. Note the following light source characteristics in the format "Use Only LED":

- a. Correlated Color Temperature (CCT) and Color Rendering Index (CRI) for all luminaires.
- b. Driver and dimming protocol.

All markings related to light source type must be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when light sources are in place. LED drivers must have clear markings indicating dimming type and indicate proper terminals for the various outputs.

2.9 FACTORY APPLIED FINISH

NEMA 250. Provide all luminaires and lighting equipment with factory-applied painting system that as a minimum, meets requirements of corrosion-resistance testing.

PART 3 EXECUTION

3.1 INSTALLATION

IEEE C2, NFPA 70.

3.1.1 Light Sources

When light sources are not provided as an integral part of the luminaire, deliver light sources of the type, wattage, lumen output, color temperature (CCT), color rendering index (CRI), and voltage rating indicated to the project site and install just prior to project completion, if not already installed in the luminaires from the factory.

3.1.2 Luminaires

Set luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent luminaires and secure in accordance with manufacturers' directions and approved drawings. Provide accessories as required for ceiling construction type indicated on Finish Schedule. Luminaire catalog numbers do not necessarily denote specific mounting accessories for type of ceiling in which a luminaire may be installed. Provide wires, straps, or rods for luminaire support in this section. Install luminaires with vent holes free of air blocking obstacles.

3.1.2.1 Suspended Luminaires

Measure mounting heights from the bottom of the luminaire for ceiling-mounted luminaires and to center of luminaire for wall-mounted luminaires. Obtain architect approval of the exact mounting height on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Support suspended luminaires from structural framework of ceiling or from inserts cast into slab.

- a. Provide suspended luminaires with 45 degree swivel hangers so that they hang plumb and level.
- b. Locate so that there are no obstructions within the 45 degree range in all directions.
- c. The stem, canopy and luminaire must be capable of 45 degree swing.
- d. Rigid pendent stem, aircraft cable, rods, or chains 4 feet or longer excluding luminaire must be braced to prevent swaying using three cables at 120 degree separation.
- e. Suspended luminaires in continuous rows must have internal wireway systems for end to end wiring and must be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces.
- f. Utilize aligning splines on extruded aluminum luminaires to assure minimal hairline joints.
- g. Support steel luminaires to prevent "oil-canning" effects.
- h. Match supporting pendants with supported luminaire. Aircraft cable must be stainless steel.
- i. Match finish of canopies to match the ceiling, and provide low profile canopies unless otherwise shown.
- j. Maximum distance between suspension points must be 10 feet or as recommended by the manufacturer, whichever is less.

3.1.2.2 Recessed and Semi-Recessed Luminaires

- a. Support recessed and semi-recessed luminaires independently from the building structure by a minimum of two wires, straps or rods per luminaire and located near opposite corners of the luminaire. Secure horizontal movement with clips provided by manufacturer. Ceiling grid clips are not allowed as an alternative to independently supported luminaires.
- b. Support round luminaires or luminaires smaller in size than the ceiling grid independently from the building structure by a minimum of four wires, straps or rods per luminaire, spaced approximately equidistant around.
- c. Do not support luminaires by acoustical tile ceiling panels.
- d. Where luminaires of sizes less than the ceiling grid are indicated to

be centered in the acoustical panel, support each independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the luminaire.

- e. Luminaires installed in suspended ceilings must also comply with the requirements of Section 09 51 00 ACOUSTICAL CEILINGS.
- f. Adjust aperture rings on all applicable ceiling recessed luminaires to accommodate various ceiling material thickness. Coordinate cut-out size in ceiling to ensure aperture covers cut-out entirely. Install aperture rings such that the bottom of the ring is flush with finished ceiling or not more than 1/16 inch above. Do not install luminaires such that the aperture ring extends below the finished ceiling surface.
- g. For luminaire recessed in plaster ceilings, provide plaster frames for setting. Install setting such that the bottom of the frame is flush with finished ceiling. Support luminaires with plaster frames utilizing yokes or leveling lugs. Do not mount luminaires or support elements to ducts or pipes. Yokes must support a luminaire by no fewer than two bolts each.

3.1.2.3 Field Applied Painting

Paint lighting equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Provide painting as specified in Section 09 90 00 PAINTS AND COATINGS.

3.1.3 LED Drivers

Provide LED drivers integral to luminaire as constructed by the manufacturer.

3.1.4 Exit Signs

NFPA 101. Wire exit signs and emergency lighting units ahead of the local switch, to the normal lighting circuit located in the same room or area.

3.1.5 Lighting Controls

Refer to Section 25 05 11.01. CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS for additional lighting control installation requirements.

3.1.5.1 Occupancy/Vacancy Sensors

- a. Provide quantity of sensor units indicated as a minimum. Provide additional units to give full coverage over controlled area. Full coverage must provide hand and arm motion detection for office and administration type areas and walking motion for industrial areas, warehouses, storage rooms and hallways.
- b. Locate ceiling-mounted sensors no closer than 6 feet from the nearest HVAC supply or return diffuser.
- c. Locate the sensor(s) as indicated and in accordance with the manufacturer's recommendations.

3.1.5.2 Photosensors

Locate and aim sensor as indicated and in accordance with the

manufacturer's recommendations. Adjust sensor set-point in accordance with the manufacturer's recommendations and for the indicated light level of the area of coverage, measured at the work plane.

3.2 FIELD QUALITY CONTROL

3.2.1 Tests

3.2.1.1 Lighting Control Verification Tests

Verify lighting control system and devices operate according to approved sequence of operations. Verification tests are to be completed after commissioning.

- a. Verify occupancy/vacancy sensors operate as described in sequence of operations. Provide testing of sensor coverage, sensitivity, and time-out settings in all spaces where sensors are placed. This is to be completed only after all furnishings have been installed. Submit occupancy/vacancy sensor verification test.
- b. Verify photosensors operate as described in sequence of operations. Provide testing of sensor coverage, aiming, and calibration in all spaces where sensors are placed. This is to be completed only after all furnishings have been installed. Submit photosensor verification test.
- c. Verify wall box dimmers and scene wallstations operate as described in sequence of operations.

3.2.1.2 Emergency Lighting Test

Interrupt power supply to demonstrate proper operation of emergency lighting. If adjustments are made to the lighting system, re-test system to show compliance with standards.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Commissioning

NFPA 101. Commission all components of the lighting system and lighting control system in accordance with Section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING. Factory Trained Field Service Technician is responsible for calibration and programming sequences for input devices and systems in accordance with the requirements described in the sequence of operation.

3.3.2 Training

3.3.2.1 Maintenance Staff Training

Submit a Maintenance Staff Training Plan at least 30 calendar days prior to training session that describes training procedures for Owner's personnel in the operation and maintenance of lighting and lighting control system. Provide on-site training which demonstrates full system functionality, assigning schedules, calibration adjustments for light levels and sensor sensitivity, integration procedures for connecting to third-party devices, and manual override including information on appropriate use. Provide protocols for troubleshooting, maintenance, repair, and replacement, and literature on available system updates and process for implementing updates.

3.3.2.2 End-User Training

Submit an End-User Training Plan at least 30 calendar days prior to training session that describes training procedures for end-users on the lighting control system. Provide users with a list of control devices located within user-occupied spaces, such as photosensors and occupancy and vacancy sensors, including information on the proper operation and schedule for each device. Provide demonstration for each type of interface. Provide users with the building schedule as currently commissioned, including conditional programming based on astronomic time clock functionality. Provide users with the correct contact information for maintenance personnel who will be available to address any lighting control issues.

Provide laminated instructions to the user at each scene wallstation. Provide only instructions relevant to the functionality of the specific scene wallstation. Provide a description of each labeled scene control button. If the room utilizes occupancy/vacancy sensors or photosensors, include a description of this functionality on the instruction sheet.

-- End of Section --

SECTION 26 56 00

EXTERIOR LIGHTING

05/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO LTS (2013; Errata 2013) Standard
Specifications for Structural Supports for
Highway Signs, Luminaires and Traffic
Signals

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16 (2017; Errata 2018; Supp 1 2018) Minimum
Design Loads and Associated Criteria for
Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products

ASTM A153/A153M (2016a) Standard Specification for Zinc
Coating (Hot-Dip) on Iron and Steel
Hardware

ASTM A709/A709M (2018) Standard Specification for
Structural Steel for Bridges

ASTM A780/A780M (2020) Standard Practice for Repair of
Damaged and Uncoated Areas of Hot-Dip
Galvanized Coatings

ASTM B117 (2019) Standard Practice for Operating
Salt Spray (Fog) Apparatus

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC ES AC156 (2012) Acceptable Criteria for Seismic
Certification by Shake-Table Testing of
Nonstructural Components

ILLUMINATING ENGINEERING SOCIETY (IES)

IES HB-10 (2011; Errata 2015) IES Lighting Handbook

IES LM-79 (2008) Electrical and Photometric

Measurements of Solid-State Lighting
Products

IES LM-80	(2019) Measuring Lumen Maintenance of LED Light Sources
IES RP-8	(2018; Addenda 1 2020) Recommended Practice for Lighting Roadway and Parking Facilities
IES RP-16	(2017) Nomenclature and Definitions for Illuminating Engineering
IES TM-15	(2011) Luminaire Classification System for Outdoor Luminaires
IES TM-21	(2019) Projecting Long Term Lumen Maintenance of LED Light Sources

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C136.3	(2020) Roadway and Area Lighting Equipment - Luminaire Attachments
ANSI C136.13	(2014) Roadway and Area Lighting Equipment - Metal Brackets for Wood Poles
ANSI C136.21	(2014) American National Standard for Roadway and Area Lighting Equipment - Vertical Tenons Used with Post-Top-Mounted Luminaires
NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.377	(2017) Electric Lamps- Specifications for the Chromaticity of Solid State Lighting Products
NEMA C82.77-10	(2020) Harmonic Emission Limits - Related Power Quality Requirements
NEMA C136.31	(2018) Roadway and Area Lighting Equipment - Luminaire Vibration
NEMA SSL 1	(2016) Electronic Drivers for LED Devices, Arrays, or Systems

NEMA SSL 3 (2011) High-Power White LED Binning for
General Illumination

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-02 (2020) Design of Risk Category V
Structures, National Strategic Military
Assets

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 150/5345-43 (2019; Rev J) Specification for
Obstruction Lighting Equipment

UNDERWRITERS LABORATORIES (UL)

UL 773 (2016; Reprint Jul 2020) UL Standard for
Safety Plug-In, Locking Type Photocontrols
for Use with Area Lighting

UL 773A (2016; Reprint Jun 2020) UL Standard for
Safety Nonindustrial Photoelectric
Switches for Lighting Control

UL 1310 (2018) UL Standard for Safety Class 2
Power Units

UL 1598 (2021; Reprint Jun 2021) Luminaires

UL 8750 (2015; Reprint Sep 2020) UL Standard for
Safety Light Emitting Diode (LED)
Equipment for Use in Lighting Products

1.2 RELATED REQUIREMENTS

Materials not considered to be luminaires, luminaire accessories, or lighting equipment are specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Luminaires and accessories installed in interior of buildings or attached to the exterior of a building are specified in Section 26 51 00 INTERIOR LIGHTING. Cybersecurity requirements are specified in Section 25 05 11.01. CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS. Commissioning requirements for Navy projects are specified in Section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING.

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications and on the drawings must be as defined in IEEE 100 and IES RP-16.
- b. For LED luminaire light sources, "Useful Life" is the operating hours before reaching 70 percent of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions. This

is also known as 70 percent "Rated Lumen Maintenance Life" as defined in IES LM-80.

- c. For LED luminaires, "Luminaire Efficacy" (LE) is the appropriate measure of energy efficiency, measured in lumens/watt. This is gathered from LM-79 data for the luminaire, in which absolute photometry is used to measure the lumen output of the luminaire as one entity, not the source separately and then the source and housing together.
- d. Total Harmonic Distortion (THD) is the Root Mean Square (RMS) of all the harmonic components divided by the total fundamental current.
- e. The "Groundline Section" of wood poles is that portion of the pole between one foot above, and 2 feet below the groundline.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

High Mast Tower Drawings; G

Fixed Head Assembly; G

Luminaire Ring; G

Luminaire Drawings; G

Pole Drawings; G

Control System One-Line Diagram; G

Sequence of Operation for Exterior Lighting Control System; G

SD-03 Product Data

High Mast Tower; G

Fixed Head Assembly; G

Luminaire Ring; G

Lowering Device; G

Drive Motor Set; G

Obstruction Lighting; G

Luminaires; G

Light Sources; G

LED Drivers; G

Luminaire Warranty; G

Lighting Controls Warranty; G

Pole Warranty; G

Photosensors; G

Poles; G

Brackets

SD-05 Design Data

High Mast Tower Design Data; G

Luminaire Design Data; G

SD-06 Test Reports

IES LM-79 Test Report

IES LM-80 Test Report

IES TM-21 Test Report

SD-08 Manufacturer's Instructions

Poles

SD-10 Operation and Maintenance Data

Lighting System, Data Package 5; G

Exterior Lighting Control System, Data Package 5; G

Maintenance Staff Training Plan; G

End-User Training Plan; G

1.5 QUALITY ASSURANCE

Data, drawings, and reports must employ the terminology, classifications and methods prescribed by the IES HB-10 as applicable, for the lighting system specified.

1.5.1 Drawing Requirements

1.5.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), weight, accessories, and installation and construction details. Photometric data, including CRI, CCT, TM-15-11 BUG rating, LED driver type, zonal lumen data, and candlepower distribution data per LM-79 must accompany shop drawings.

1.5.1.2 Pole Drawings

Include dimensions, wind load determined in accordance with AASHTO LTS ASCE 7-16, pole deflection, pole class, and other applicable information.

1.5.2 Luminaire Design Data

- a. Provide distribution data according to IES classification type as defined in IES HB-10 and IES RP-8.
- b. B.U.G. rating for the installed position as defined by IES TM-15 and shielding as defined by IES RP-8.
- c. Provide safety certification and file number for the luminaire family. Include listing, labeling and identification in accordance with NFPA 70 (NEC). Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratories).
- d. Provide long term lumen maintenance projections for each LED luminaire in accordance with IES TM-21. Data used for projections must be obtained from testing in accordance with IES LM-80.
- e. Provide wind loading calculations for luminaires mounted on poles. Weight and effective projected area (EPA) of luminaires and mounting brackets must not exceed maximum rating of pole as installed in particular wind zone area.

1.5.3 IES LM-79 Test Report

Submit test report on manufacturer's standard production model of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data as outlined under "14.0 Test Report" in IES LM-79.

1.5.4 IES LM-80 Test Report

Submit report on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data as outlined under "8.0 Test Report" in IES LM-80.

1.5.5 IES TM-21 Test Report

Submit test report on manufacturer's standard production LED light source (package, array or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data, as well as required interpolation information as outlined under "7.0 Report" in IES TM-21.

1.5.6 High Mast Tower Design Data

- a. For high mast towers, design conforming to AASHTO LRFDLTS-1 with interim revisions. Design the completed unit to withstand static and dynamic loads the unit will be subjected to in service. Use a design loading that provides for installation of the full complement of 6 luminaires and the operation of the lowering device.
- b. Design the high mast light tower using a design life of 50 years with a wind importance factor of 1.00. Design to withstand a 3 second gust

wind speed of 120 mph.

- c. Design the tower and its connections, including but not limited to the welds and anchor rods, to the AASHTO fatigue category I criteria. Use the fatigue importance factors for category I tabulated in the AASHTO standards.
- d. Use towers that are round or polygonal in section and designed so that the horizontal tower deflection in any direction at the design wind velocity with a gust effect factor does not exceed 5 percent of the tower height. Measure the horizontal deflection from the vertical plane passing through the centerline of the tower at its base. The tower height is the distance from the bottom of the base plate to the top of the shaft, excluding the fixed head assembly.
- e. Submit high mast tower drawings identified by structure number, design computations, and material specifications. Certify that shop drawings conform to contract documents with each set of shop drawings. Provide component lists, showing the tower, its alloy identification, plate thickness, weld details, weld procedures, and tolerances; the anchor assembly; the fixed head assembly; the lowering device; luminaire ring; other required apparatus. Have a registered professional engineer sign, seal, and date the shop drawings and certify that the design conforms to AASHTO LRFDLTS-1 with interim revisions, and to the contract documents.
- f. If substantial changes from previously submitted calculations and drawings are made, submit the revisions for review.

1.5.7 Test Laboratories

Test laboratories for the IES LM-79 and IES LM-80 test reports must be one of the following:

- a. National Voluntary Laboratory Accreditation Program (NVLAP) accredited for solid-state lighting testing as part of the Energy-Efficient Lighting Products laboratory accreditation program.
- b. One of the qualified labs listed on the Department of Energy - Energy Efficiency & Renewable Energy, Solid-State Lighting web site.
- c. One of the EPA-Recognized Laboratories listed at for LM-80 testing.

1.5.8 Regulatory Requirements

Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated. Provide luminaires and assembled components that are approved by and bear the label of UL for the applicable location and conditions unless otherwise specified.

1.5.9 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for six months prior to bid opening. The six-month period must include applications of equipment and materials under similar circumstances and of similar size. The product must have

been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the six-month period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.9.1 Alternative Qualifications

Products having less than a six-month field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.9.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than six months prior to date of delivery to site, unless specified otherwise.

1.6 DELIVERY, STORAGE, AND HANDLING OF POLES

1.6.1 High Mast Tower

- a. Store bolts/nut/washer/DTI assemblies in closed containers in a protected shelter to protect them from dirt and moisture until used. Maintain fastener system components as nearly as possible in the as-manufactured condition until installed. Remove from storage only as needed and promptly return unused components to storage.
- b. Protect galvanized members from damage to galvanization during transportation, storage, and erection. Repair areas of damaged galvanization according to ASTM A780/A780M. Clean damaged and adjacent areas by sanding, scraping, chipping, or wire brushing. Apply a profile to the bare metal surface using a needle gun before painting.

1.6.2 Steel Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.7 WARRANTY

Support all equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7.1 Luminaire Warranty

Provide and transfer to the government the original LED luminaire manufacturers standard commercial warranty for each different luminaire manufacturer used in the project.

- a. Provide a written five year minimum replacement warranty for material, luminaire finish, and workmanship. Provide written warranty document that contains all warranty processing information needed, including customer service point of contact, whether or not a return

authorization number is required, return shipping information, and closest return location to the luminaire location.

(1) Finish warranty must include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

(2) Material warranty must include:

(a) All LED drivers and integral control equipment.

(b) Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective, non-starting, or operating below 70 percent of specified lumen output.

b. Warranty period must begin in accordance with the manufacturer's standard warranty starting date.

c. Provide replacements that are promptly shipped, without charge, to the using Government facility point of contact and that are identical to or an improvement upon the original equipment. All replacements must include testing of new components and installation.

1.7.2 Lighting Controls Warranty

Provide and transfer to the government the original lighting controls manufacturers standard commercial warranty for each different lighting controls manufacturer used in the project. Warranty coverage must begin from date of final system commissioning or three months from date of delivery, whichever is the earliest. Warranty service must be performed by a factory-trained engineer or technician.

a. Unless otherwise noted, provide a written five year minimum warranty on the complete system for all systems with factory commissioning. Provide warranty that covers 100 percent of the cost of any replacement parts and services required over the five years which are directly attributable to the product failure. Failures include, but are not limited to, the following:

(1) Software: Failure of input/output to execute switching or dimming commands.

(2) Damage of electronic components due to transient voltage surges.

(3) Failure of control devices, including but not limited to photosensors and motion sensors.

b. Provide a written five year minimum warranty on all input devices against defect in workmanship or materials provided by device manufacturer.

c. Provide a written five year minimum warranty on all control components attached to luminaires against defect in workmanship or materials.

1.7.3 Pole Warranty

Provide and transfer to the government the original pole manufacturers standard commercial warranty for each different pole manufacturer used in the project. Warranty coverage must begin from date of final system commissioning or three months from date of delivery, whichever is the

earliest. Provide a written three year minimum replacement warranty for material, luminaire finish, and workmanship. Warranty service must be performed by a factory-trained engineer or technician.

1.8 OPERATION AND MAINTENANCE MANUALS

1.8.1 Lighting System

Provide operation and maintenance manuals for the lighting system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the lighting system. Additional requirements for the Navy are provided in Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Include the following:

- a. Manufacturers' operating and maintenance manuals.
- b. Luminaire shop drawings for modified and custom luminaires.
- c. Luminaire Manufacturers' standard commercial warranty information as specified in paragraph LUMINAIRE WARRANTY.

1.8.2 Exterior Lighting Control System

Provide operation and maintenance manuals for the exterior lighting control system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the exterior lighting control system. Include the following:

- a. Control System One-Line Diagram
- b. Product data for all devices, including installation and programming instructions.
- c. Training materials, such as videos or in-depth manuals, that cover basic operation of the lighting control system and instructions on modifying the control system. Training materials must include calibration, adjustment, troubleshooting, maintenance, repair, and replacement.

1.8.3 High Mast Lighting System

Provide operation and maintenance manuals for the high mast lighting system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, installation, operation, and maintenance of the high mast lighting system. Include the following:

- a. Spare parts lists.
- b. Lubrication charts.
- c. Lubricating procedures
- d. Recommended maintenance schedules.
- e. Index and cross reference materials using a table of contents at the beginning of the manual.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

2.2 LUMINAIRES

UL 1598, NEMA C82.77-10. Provide luminaires as indicated in the luminaire schedule and XL plates or details on project plans, complete with light source, wattage, and lumen output indicated. All luminaires of the same type must be provided by the same manufacturer. Luminaires must be specifically designed for use with the LED driver and light source provided.

2.2.1 Luminaires

UL 8750, IES LM-79, IES LM-80. For all luminaires, provide:

- a. Complete system with LED drivers and light sources.
- b. Housing constructed of non-corrosive materials. All new aluminum housings must be anodized or powder-coated. All new steel housings must be treated to be corrosion resistant.
- c. IES TM-21, IES LM-80. Minimum L70 lumen maintenance value of 50,000 hours unless otherwise indicated in the luminaire schedule. Luminaire drive current value must be identical to that provided by test data for luminaire in question.
- d. Minimum efficacy as specified in the luminaire schedule. Theoretical models of initial lamp lumens per watt are not acceptable. If efficacy values are not listed in the luminaire schedule, provide luminaires that meet the following minimum values:

Luminaire Style	Minimum Luminaire Efficacy
Area and Roadway (pole mounted, arm mounted)	95 LPW
Pedestrian Post-Top (pole mounted, arm mounted)	90 LPW
Bollard	35 LPW
Accent (adjustable landscape, sign lighting)	35 LPW
Exterior Wall Sconce	50 LPW

- e. Product rated for operation within an ambient temperature range of minus 22 degrees F to 122 degrees F.
- f. UL listed for wet locations.
- g. IES HB-10. Light distribution and NEMA field angle classifications as indicated in luminaire schedule on project plans.
- h. Housing finish that is baked-on enamel, anodized, or baked-on powder coat paint. Finish must be capable of surviving ASTM B117 salt fog environment testing for 2500 hours minimum without blistering or peeling.

- i. LED driver and light source package, array, or module are accessible for service or replacement without removal or destruction of luminaire.
- j. IES TM-15. Does not exceed the BUG ratings as listed in the luminaire schedule. If BUG ratings are not listed in the luminaire schedule, provide luminaires that meet the following minimum values for each application and mounting conditions:

Lighting Application	Mounting Conditions	BUG Rating
Area and Roadway	All	B3-U0-G3
Pedestrian Post-Top	All	B2-U1-G1
Exterior Wall Sconce	Above 4 feet AFF	B1-U0-G2
Exterior Wall Sconce	Below or at 4 feet AFF	B4-U0-G4

- k. Fully assembled and electrically tested prior to shipment from factory.
- l. Finish color is as indicated in the luminaire schedule or detail on the project plans.
- m. Lenses constructed of clear tempered glass or UV-resistant acrylic.
- n. All factory electrical connections are made using crimp, locking, or latching style connectors. Twist-style wire nuts are not acceptable.
- o. NEMA C136.31. Comply with 3G vibration testing.
- p. Luminaire arm bolts constructed from 304 stainless steel or zinc-plated steel.

2.3 LIGHT SOURCES

NEMA ANSLG C78.377, NEMA SSL 3. Provide type, lumen rating, and wattage as indicated in luminaire schedule on project plans.

2.3.1 LED Light Sources

Provide LED light sources that meet the following requirements:

- a. NEMA ANSLG C78.377. Emit white light and have a nominal Correlated Color Temperature (CCT) of 4000 Kelvin.
- b. Minimum Color Rendering Index (CRI) of 70.
- c. Light source color consistency by utilizing a binning tolerance within a 4-step McAdam ellipse.

2.4 LED DRIVERS

NEMA SSL 1, UL 1310. Provide LED Drivers that are electronic, UL Class 1 or Class 2, constant-current type and meet the following requirements:

- a. The combined LED driver and LED light source system is greater than or equal to the minimum luminaire efficacy values as listed in the luminaire schedule provided.

- b. Operate at a voltage of 277 volts at 50/60 hertz, with input voltage fluctuations of plus or minus 10 percent.
- c. Power Factor (PF) greater than or equal to 0.90 at full input power and across specified dimming range.
- d. Maximum Total Harmonic Distortion (THD) less than or equal to 20 percent at full input power and across specified dimming range.
- e. Operates for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.
- f. Meets the "Elevated" (10kV/10kA) requirements per IEEE C62.41.2 -2002. Manufacturer must indicate whether failure of the electrical immunity system can possibly result in disconnect of power to luminaire. Provide surge protection that is integral to the LED driver.
- g. Contains integral thermal protection that reduces the output power to protect the driver and light source from damage if the case temperature approaches or exceeds the driver's maximum operating temperature.
- h. Complies with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 15, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
- i. Class A sound rating for all drivers mounted under a covered structure, such as a canopy, or where otherwise appropriate.
- k. UL listed for wet locations typical of exterior installations.
- l. Rated to operate between ambient temperatures of minus 22 degrees F and 104 degrees F.

2.5 LIGHTING CONTROLS

2.5.1 System

Provide exterior lighting control system that operates the exterior lighting system as described in the exterior lighting control strategies in the project plans. Submit Sequence of Operation for Exterior Lighting Control System describing the operation of the proposed exterior lighting control system and devices. Sequence of Operation must provide the strategies identified in the exterior lighting control strategies.

2.5.2 Devices

2.5.2.1 Photosensors

UL 773, UL 773A. Provide Photosensors that meet the following requirements:

- a. Hermetically sealed, silicon diode light sensor type, rated as indicated, 50/60 Hz with single-pole, single-throw contacts.
- b. Turns ON at 1 to 3 footcandles and turns OFF at 3 to 15 footcandles.

- c. Designed to fail to the ON position.
- d. Housing is constructed of UV stabilized polypropylene, rated to operate within a temperature range of minus 40 to 158 degrees F.
- e. Time delay that prevents accidental switching from transient light sources.
- f. Designed for 20-year service to match life expectancy of long-life LED fixtures and exceed 15,000 operations at full load. Provide photosensors with zero-cross technology to withstand severe in-rush current and extend relay life.

2.6 HIGH MAST LIGHTING SYSTEM

2.6.1 High Mast Tower

- a. Furnish pole shafts constructed of structural steel conforming to ASTM A709/A709M, Grade 50 or engineer- approved equivalent and zinc coated conforming to ASTM A123/A123M. Furnish pole shafts with a consistent taper from bottom to top, except the lower section may be expanded to accommodate the required apparatus. Furnish poles constructed in 40-foot to 50-foot sections using single thickness steel plate, except the length of the top section may be shorter to provide the required pole height.
- b. Provide a reinforced access door opening in the base of the pole shaft that secures with a cover. Furnish a cover made with stainless steel hinges that bolts shut with stainless steel hex bolts and is weather tight. Fit the cover with a stainless-steel padlock hasp.
- c. Secure the opening below the base plate with a stainless steel or galvanized steel rodent screen.
- d. Design the base plate so water does not accumulate on the top surface of the base plate inside the pole.
- e. Before zinc coating of the pole or base plate, number each anchor rod hole in sequence on the base plate or around the bottom of the pole. Locate the numbers so they are not obscured by the zinc coating or covered by installed nuts.
- f. Provide adequate room to house components, cables, splices and power units at the base of shaft:
 - (1) Winch with integral power units or winch with portable power units
 - (2) Circuit breaker enclosures
 - (3) Lowering system cables and components
 - (4) Electrical wiring, cables, splices, connectors, and components
- g. Provide circuit breaker enclosure support mount meeting the following:
 - (1) Located inside the base
 - (2) Designed to support the enclosure

- (3) Placed to provide easy access to the enclosure
- (4) Positioned in the base so the enclosure does not interfere with lowering system operations, anchor rod tightening, and the opening and closing of the base access doors and panels
- h. Provide two bonding studs meeting the following:
 - (1) Mounted inside the base in plain view when the front door and rear handhole are open for visual inspection of the ground lug terminations
 - (2) One located near the front door and the other near the rear handhole for accessibility
 - (3) Positioned to avoid interfering with normal operation of the HMLTs anchor rod tightening, and the opening and closing of the base front door and rear handhole
 - (4) Each sized properly in length and diameter to accommodate a bronze bonding lug for the lightning protection conductor, the cable copper shield of the direct buried lighting cable, and a bronze bonding lug for the green insulated stranded 6 AWG conductor from the circuit breaker enclosure
- i. Reinforced base access openings for tightening anchor rods, making electrical connections, operating the lowering system and maintaining components.
 - (1) Front openings sized at least 16 inches x 21 inches x 35 inches located at 0 degrees (base front) with hinged front doors and tamper proof fasteners to secure the opening
 - (2) Rear handhole openings sized at least 10 inches x 15 inches located at 180 degrees from the front door with bolt on access covers
 - (3) Front doors and access covers made from the same material specification as the base
- j. Bases wrapped with a covering at the factory to protect against scratches and mars during delivery and staging on the project site.

2.6.2 Lowering Device

- a. Equip the poles with a mechanical lowering system that allows servicing the luminaires and associated electrical and mechanical apparatus from the ground. Furnish lowering devices from a department- approved series and manufacturer and with a 10-year warranty against failure of its components.
- b. When fully raised, provide a method of securing the luminaire ring to the fixed head assembly. Show either a bottom latch or a top latch system for securing the luminaire ring on the drawings submitted for the engineer's review.
- c. Design top latch systems to provide the operator with a way to determine whether the raising operation is complete and the luminaire ring is secure. The operator observing clutch slippage does not meet

this requirement.

- d. If securing the luminaire ring to the fixed head assembly, provide a means to relieve tension from the lowering cables onto the winch assembly. Provide strain relief devices that allow removing the winch assembly for servicing while the luminaire ring is fully lowered and blocked up.
- e. Ensure that the lowering device operates off one leg of the line feeding the tower and uses a portable drive motor that plugs into the line.
- f. Provide adjustable torque limiters in the winch system or drive motor to prevent excessive stress on the lowering cables, and to allow for proper tensioning against the fixed head assembly.
- g. For systems where the lifting cables meet on a transition plate, provide access to the top of the plate from the hand-hole, when the ring is fully raised, to allow cable tension adjustment. Furnish 7 x 9 stainless steel lifting cables. Do not use antirotational cables.

2.6.3 Fixed Head Assembly

- a. The fixed head assembly shall include no moving parts, except for the necessary pulleys, rollers, and sheaves that guide the lowering ring, lowering cables and electrical conductors during the lowering operation. For the fixed head assembly, use stainless steel. Use pulleys, rollers, sheaves, and associated bearings, bushings, and shafts made of corrosion-resistant materials. Use permanently lubricated and sealed bearings and bushings.
- b. For systems that use a roller assembly to support the power chord at the head frame, use an assembly made of rollers mounted between highly corrosion resistant steel plates. Ensure the power chord rides on at least 6 rollers made from acetate resin mounted on stainless steel pins. Furnish a roller assembly with a minimum bending radius of 7 inches. If using a pulley, use a minimum radius of 8 inches.
- c. Furnish stainless steel lifting cable sheaves with a minimum radius of 3 inches. Use sheaves with permanently lubricated bronze bearings and a stainless steel pin. For the depth of the vee on the pulley, use at least the diameter of the cable. Provide guards to prevent the cable from lifting off the pulley.
- d. Protect all of the head assembly with covers, screens, or shields, to prevent entrance of dirt, moisture, ice accumulation, nesting of insects or birds or other contaminants that may harm the head assembly and operation of the lowering device.

2.6.4 Luminaire Ring

- a. If the plans show unused luminaire tenons, install a counterweight equal in weight to a luminaire, and close the unused tenon off with a threaded cap.
- b. Furnish a stainless steel ring.
- c. Furnish a luminaire ring centering system designed to protect both the pole shaft and the luminaire ring assemble and with a 10-year warranty

against failure of its components. Ensure that the system operates successfully in winds up to 30 mph. Also ensure that the ring can travel smoothly and unimpeded over the entire length of the pole shaft.

2.6.5 Lightning Rod

Furnish silver tipped lightning rod of engineer-approved design mechanically attached to the tower shaft or head assembly, and electrically connected to the pole shaft.

2.6.6 Miscellaneous Fittings

Use stainless steel miscellaneous fittings, fasteners, and hardware.

2.6.7 Drive Motor Set

Furnish a universal portable motor system compatible with the particular lowering system used and capable of powering that system for any combination of the pole height and luminaire load configuration. Ensure that the drive motor set consists of a 120 volt AC motor, a matching transformer, power connection cables, and a motor control switch.

2.6.8 Obstruction Lighting and Markings

2.6.8.1 Obstruction Lights

Use obstruction marker lights emitting aviation red steady burning light. Use multiple-socket assembly FAA AC 150/5345-43, Type L-810 light fixtures. Use double-unit type obstruction marker lights as indicated. Energize the obstruction lights series or multiple circuits.

Do not use LED-based obstruction lights on military facilities.

2.7 POLES

AASHTO LTS and ASCE 7-16. Provide round tapered poles designed for wind loading of 100 140 miles per hour while supporting luminaires and all other appurtenances indicated. The effective projected areas (EPA) of luminaires and appurtenances used in calculations must be specific for the actual products provided on each pole. Provide poles that are anchor-base type designed for use with underground supply conductors. Poles must have oval-shaped hand hole having a minimum clear opening of 3 by 5 inches. Secure hand hole covers by stainless steel captive screws. Provide metal poles with an internal grounding connection accessible from the hand hole near the bottom of each pole. Install a means of wire disconnection accessible from the hand hole. Do not install square poles. Provide poles from a Manufacturer with a standard provision for protecting the finish during shipment and installation. Do not install scratched, stained, chipped, or dented poles.

2.7.1 Steel Poles

Provide steel poles with hot-dipped galvanized in accordance with ASTM A123/A123M factory finish. Provide poles that meet the following requirements:

- a. Minimum 11-gage steel with minimum yield/strength of 48,000 psi
- b. Pole is mounted by anchor bolts.

- c. Consists of tapered tubular members, either round in cross section or polygonal.
- d. Pole shaft is one piece and is of welded construction with no bolts, rivets, or other means of fastening except as specifically approved.
- e. Base covers are of structural quality hot-rolled carbon steel plate, with a minimum yield of 36,000 psi.
- f. Markings are approximately 3 to 4 feet above grade and includes manufacturer, year of manufacture, top and bottom diameters, and length.
- g. Grounding connection is designed to prevent electrolysis when used with copper ground wire.

2.7.2 Brackets and Supports

ANSI C136.3, ANSI C136.13, and ANSI C136.21. Provide pole brackets that are not less than 1 1/4 inch aluminum secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets must be coordinated to luminaires provided, and brackets for use with one type of luminaire must be identical. Brackets for pole-mounted street lights must correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 24 feet above street. Provide special mountings or brackets as indicated and of metal which will not promote galvanic reaction with luminaire head.

2.7.3 Pole Foundations

Provide anchor bolts consisting of a steel rod with a minimum yield strength of 50,000 psi; the top 12 inches of the rod must be galvanized in accordance with ASTM A153/A153M. Concrete must be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.8 EQUIPMENT IDENTIFICATION

2.8.1 Manufacturer's Nameplate

Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8.2 Labels

UL 1598. Luminaires must be clearly marked for operation of specific light sources and drivers according to proper light source type. Note the following luminaire characteristics in the format "Use Only _____":

- a. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.
- b. Driver and dimming protocol.

Markings related to light source type must be clear and located to be readily visible to service personnel, but unseen from normal viewing

angles when light sources are in place. LED drivers must have clear markings indicating dimming type and indicate proper terminals for the various outputs.

2.9 FACTORY APPLIED FINISH

NEMA 250. Provide all luminaires and lighting equipment with factory-applied painting system that as a minimum meets requirements of corrosion-resistance testing.

PART 3 EXECUTION

3.1 INSTALLATION

IEEE C2, NFPA 70.

3.1.1 Luminaires

Install all luminaires in accordance with the luminaire manufacturer's written instructions. Install all luminaires at locations and heights as indicated on the project plans. Level all luminaires in accordance to manufacturer's written instructions.

3.1.2 Field-Applied Painting

Paint lighting equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Provide painting as specified in Section 09 90 00 PAINTS AND COATINGS.

3.1.3 High Mast Towers

- a. Ensure that the completed tower, with attachments, is straight and plumb throughout its height. Do not perform final plumbing on a sunny or windy day.
- b. Ensure that the surface of telescoped tower sections permanently blocks moisture from entering the faying surfaces.
- c. Set the high mast light tower joint overlap in the field as follows:
 - (1) On the male end, make a chalk mark at a distance from the end equal to the required overlap plus 1 foot.
 - (2) Make the connection so that the distance from the end of the female section to the chalk mark is 1 foot.

3.1.4 Lowering Device, Head Assembly, and Luminaire Ring

- a. Construct conforming to plan details and manufacturer's instructions.
- b. Do not erect fixed head assemblies before the engineer inspects them on the ground.

3.1.5 Aluminum Poles

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit bells, and

ground rods must be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location. After installation, paint exposed surfaces of steel poles with two finish coats of. Install according to pole manufacturer's instructions. Alterations to poles after fabrication will void manufacturer's warranty and is not allowed.

3.1.6 Pole Setting

Set pole to depth as indicated.

3.1.7 Lighting Controls

Refer to Section 25 05 11.01. CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS for additional lighting control installation requirements.

3.1.7.1 Photosensors

Aim photosensor according to manufacturer's recommendations. Mount sensor on or beside each luminaire when switch is provided in cast weatherproof aluminum housing with swivel arm.

3.1.8 Grounding

Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.2 FIELD QUALITY CONTROL

3.2.1 Tests

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Perform initial operational test, consisting of the entire system energized for 72 consecutive hours without any failures of any kind occurring in the system. All circuits must test clear of faults, grounds, and open circuits.

3.2.1.1 Lighting Control Verification Test

Verify lighting control system and devices operate according to approved sequence of operations. Verification tests are to be completed after commissioning.

3.2.1.2 High Mast System Testing

- a. Before final acceptance of each completed high mast lighting tower installation, demonstrate to the engineer that electrical and mechanical systems function properly.
- b. Test each completed high mast lighting unit by fully raising, latching, unlatching, and fully lowering the luminaire ring assembly at least 2 times. After each raising and lowering sequence the

Contracting Officer will inspect the following:

- (1) Winch and power unit
 - (2) Winch and supporting cables
 - (3) Power cable
 - (4) Luminaire ring assembly
 - (5) Latching system
- c. Stop the test if problems or failures occur. After the problem or failure has been corrected the test will be repeated in full.
 - d. Untwist twisted cables and ensure cables are wound evenly on the drums before each raising and lowering sequence.
 - e. Ensure cables are wound evenly on the drums, and the luminaire ring is fully raised, latched, and level after the test has been completed.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Training

Provide on-site training to the Owner's personnel in the operation and maintenance of lighting and lighting control system. Provide training that includes calibration, adjustment, troubleshooting, maintenance, repair, and replacement.

3.3.1.1 Maintenance Staff Training

Submit a Maintenance Staff Training Plan at least 30 calendar days prior to training session that describes training procedures for Owner's personnel in the operation and maintenance of lighting and lighting control system. Provide on-site training which demonstrate full system functionality, assigning schedules, calibration adjustments for light levels and sensor sensitivity, integration procedures for connecting to third-party devices, and manual override including information on appropriate use. Provide protocols for troubleshooting, maintenance, repair, and replacement, and literature on available system updates and process for implementing updates.

3.3.1.2 End-User Training

Submit a End-User Training Plan at least 30 calendar days prior to training session that describes training procedures for end-users on the lighting control system. Provide demonstration for each type of user interface. Provide users with the curfew schedule as currently commissioned, including conditional programming based on astronomic time clock functionality. Provide users with the correct contact information for maintenance personnel who will be available to address any lighting control issues.

3.4 Special Testing for Seismic-Resisting Equipment

Pier lighting fixtures and poles are to remain operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide

a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise. Seismic component qualification documentation for each piece of equipment must contain the information required in UFC 3-301-02, Section 2-17.2.5 Component Qualification Documentation. Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be less than 5 inches by 7 inches with red letters 1-inch in height on a white background stating "Certified Equipment". The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file". The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

3.5 Special Inspection for Seismic-Resisting Systems and Equipment

Perform special inspections for seismic-resisting systems, equipment and components for structures assigned to Risk Category IV per Section 01 45 35 SPECIAL INSPECTIONS.

-- End of Section --

SECTION 27 05 13.43

TELEVISION DISTRIBUTION SYSTEM
05/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

NATIONAL CABLE AND TELECOMMUNICATIONS ASSOCIATION (NCTA)

NCTA RP (1989) NCTA Recommended Practices for
Measurements on Cable Television Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 76.605 Technical Standards

UNDERWRITERS LABORATORIES (UL)

UL 969 (2017; Reprint Mar 2018) UL Standard for
Safety Marking and Labeling Systems

1.2 DEFINITIONS

1.2.1 Television Distribution System

The television distribution system system, commonly referred to as cable television, is a network of cables, and passive components for distribution of adequate signals to each receiver from the headend equipment to the individual television outlets.

1.2.2 Distribution System

Distribution system transports adequate signals to each outlet.

1.2.3 Cable

Trunk and feeder cables are low-loss cables used to transport the desired signal the telecommunications room in the area to be served. These cables are used to transport signal from the telecommunications room into close proximity to a number of user locations in excess of 200 feet from the telecommunications room. Drop cables are used to transport the desired

signal used from the telecommunications closet room to the wall outlet.

1.3 SYSTEM DESCRIPTION

1.3.1 Distribution System

Distribution system shall be star topology with each outlet connected to telecommunications room with the drop cable.

1.3.2 Cable

Provide drop cables to transport the desired signal from the telecommunications room to the outlet.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Television Distribution System Wiring Diagrams And Installation Details; G

Television Distribution System Components; G

SD-03 Product Data

Cables, including Trunk, Feeder, and Drop; G

Terminators; G

Splitters/Combiners; G

Line Taps; G

Coaxial Outlets; G

Coaxial Connectors; G

Submittals for each manufactured item must be the current manufacturer's descriptive literature of catalog products, equipment drawings, diagrams, performance and characteristics curves, and catalog cuts.

SD-05 Design Data

Television Distribution System Loss Calculations; G

SD-06 Test Reports

Operational Test Plan; G

Operational Test Procedures; G

System Pretest; G

Acceptance Tests; G

SD-08 Manufacturer's Instructions

Connector Installation; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Submit Data Package 5 for each component in accordance with
requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.5 QUALITY ASSURANCE

1.5.1 Wiring Diagrams and Installation Details

Illustrate how each item of equipment functions in the system and include an overall system schematic indicating the relationship of television distribution system units on one diagram. Drawings must include wiring diagrams and installation details of equipment indicating proposed locations, layout and arrangements, and other items that must be shown to ensure coordinated installation.

1.5.2 Operational Test Plan

Test plan must define tests required to ensure that the system meets technical, operational, and performance specifications. Test plan must be based on NCTA RP and be in accordance with FCC proof of performance requirements. Test plan must include plan for testing for signal leakage. Provide test requirements and guidelines.

1.5.3 Operational Test Procedures

Use test plan and design documents to develop test procedures. Procedures must consist of detailed instructions for a test setup, execution, and evaluation of test results.

1.5.4 Connector Installation

Provide manufacturer's instructions for installing connectors.

PART 2 PRODUCTS

2.1 DISTRIBUTION EQUIPMENT

2.1.1 Cables and Associated Hardware

Cabling shall be UL listed for the application and shall comply with NFPA 70. Provide a labeling system for cabling as required by UL 969. Cabling manufactured more than 12 months prior to date of installation shall not be used.

2.1.1.1 Drop Cable

UL 1581. Provide RG 6 coaxial cable with an NFPA 70 rating of CATVP and with the following characteristics:

- a. No. 18 AWG copper-clad steel center conductor.

- b. Bonded foil inner-shield and 90 percent aluminum braid.
- c. Characteristic impedance of 75 ohms.
- d. Gas injected foam polyethylene dielectric
- e. Nominal capacitance, conductor to shield, of 16.2 pf per 100 ft .
- f. Maximum operating voltage of 350 V RMS.
- g. Maximum attenuation:

CATVP	
MHz	DB/100 ft
10	0.7
50	1.5
100	2.1
200	3.1
400	4.5
500	6.0
700	6.9
1000	7.3

- h. Black polyvinyl chloride (PVC) jacket.
- i. 100 percent sweep testing from 5 MHz to a minimum of 1000 MHz.

2.1.2 Terminators

Coaxial terminators shall be rated for 75 ohms and 1/4 watt.

2.1.3 Line Taps

Line taps shall have 18 dB minimum isolation from each tap to the thru-line. Pressure tapoffs are not permitted. Taps shall be rated from 5 to 1000 MHz and shall have a peak to valley not to exceed 1 dB to 1 GHz.

2.1.4 Coaxial Outlets

Provide flush mounted, 75-ohm, F-type connector outlets rated from 5 to 1000 MHz in standard electrical outlet boxes.

2.1.5 Coaxial Connectors

Provide one piece connectors. Drop cable connectors shall be feed thru type.

2.2 GROUNDING AND BONDING

Provide ground rods and connections in accordance with Section 26 20 00
INTERIOR DISTRIBUTION SYSTEM.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Distribution System

Distribution system shall conform to requirements specified herein.
Installation shall be in accordance with IEEE C2 and NFPA 70.

3.1.1.1 Raceway

Provide cable installed in raceways such as conduit and cable trays in
compliance with NFPA 70. Raceway shall comply with Section 26 20 00,
INTERIOR DISTRIBUTION SYSTEM.

3.1.1.2 Grounding System

Ground this device according to the requirements of IEEE C2 and NFPA 70.

3.1.1.3 Trunk, Feeder, and Drop Cable

Provide cable to grounding blocks, to line taps, and to outlets.

3.2 FIELD QUALITY CONTROL

3.2.1 System Pretest

Upon completing installation of the television distribution system, the
Contractor shall perform complete pretesting. During the system pretest,
Contractor, utilizing the approved spectrum analyzer or signal level
meter, shall verify that the system is fully operational and meets all the
system performance requirements of the specification. Contractor shall
test the signal loss in dBmV at 55, 151, 547, and 1000 MHz. The signal
levels shall be 0 dBmV (1000 microvolts), minimum. The signal shall not
exceed 15 dBmV over the entire system bandwidth. Any deficiencies found
shall be corrected and revalidated by follow up testing. Contractor shall
measure and record the video and audio carrier levels at each of the
frequency levels specified at each of the following points in the system:

c. At each outlet.

3.2.2 Acceptance Tests

Contractor shall notify the Contracting Officer of system readiness 10
days prior to the date of acceptance testing. Contractor shall also
coordinate with the local television service provider and allow them to
attend witness tests. The television distribution system shall be tested
in accordance with the approved test plan in the presence of the
Contracting Officer's representative to certify acceptable performance.
System test shall verify that the total system meets all the requirements
of the specification and complies with the specified standards.
Contractor shall verify that no signal leakage exists in conformance with
NCTA RP and 47 CFR 76.605. System leakage shall also be tested at the
headend location with signal applied to system. Deficiencies revealed by

the testing shall be corrected on the outlets sampled as well as on the outlets not sampled and revalidated by follow-up testing. Contractor shall conduct testing at each of the following points in the system:

- a. At each outlet.

3.3 OPERATION AND MAINTENANCE MANUALS

Submit commercial, off-the-shelf manuals for operation, installation, configuration, and maintenance of products provided as a part of the cable television premises distribution system.

-- End of Section --

SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM

08/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709 (2017) Standard Specification for
Laminated Thermosetting Materials

ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

ECIA EIA/ECA 310-E (2005) Cabinets, Racks, Panels, and
Associated Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative
Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-83-596 (2016) Indoor Optical Fiber Cables

ICEA S-90-661 (2012) Category 3, 5, & 5e Individually
Unshielded Twisted Pair Indoor Cables for
Use in General Purpose and LAN
Communications Wiring Systems Technical
Requirements

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA/BICSI 568 (2006) Standard for Installing Building
Telecommunications Cabling

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 66 (2019) Performance Standard for Category 6
and Category 7 100 Ohm Shielded and
Unshielded Twisted Pairs

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-21 (1988a; R 2012) FOTP-21 - Mating

Durability of Fiber Optic Interconnecting
Devices

TIA-526-7	(2015a) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
TIA-568.0-E	(March 2020) Generic Telecommunications Cabling for Customer Premises
TIA-568.1-E	(March 2020) Commercial Building Telecommunications Cabling Standard
TIA-568.2-D	(September 2018) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-568.3-D	(October 2016) Optical Fiber Cabling Components Standard
TIA-569	(2015d) Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-606	(2017c) Administration Standard for the Telecommunications Infrastructure
TIA-607	(2015c; Addendum 1 2017) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA-1152	(2009) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
TIA/EIA-598	(2014D; Add 2 2018) Optical Fiber Cable Color Coding
TIA/EIA-604-2	(2004b; R 2014) FOCIS 2 Fiber Optic Connector Intermateability Standard
TIA/EIA-604-10	(2002a) FOCIS 10 Fiber Optic Connector Intermateability Standard - Type LC

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 68	Connection of Terminal Equipment to the Telephone Network (47 CFR 68)
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UNDERWRITERS LABORATORIES (UL)

UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 444	(2008; Reprint Apr 2015) Communications Cables
UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment

UL 508	(2018; Reprint Jul 2021) UL Standard for Safety Industrial Control Equipment
UL 514C	(2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 969	(2017; Reprint Mar 2018) UL Standard for Safety Marking and Labeling Systems
UL 1286	(2008; Reprint Jan 2018) UL Standard for Safety Office Furnishings
UL 1666	(2007; Reprint Jun 2012) Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
UL 1863	(2004; Reprint Oct 2019) UL Standard for Safety Communication Circuit Accessories

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and Section 33 82 00 TELECOMMUNICATIONS, OUTSIDE PLANT (OSP), apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568.1-E, TIA-568.2-D, TIA-568.3-D, TIA-569, TIA-606 and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

1.3.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.3.3 Floor Distributor (FD)

A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

1.3.4 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.3.5 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service

cables (including wireless) including the entrance point at the building wall and continuing to the equipment room.

1.3.6 Equipment Room (ER) (Telecommunications)

An environmentally controlled centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.7 Open Cable

Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

1.3.8 Open Office

A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.

1.3.9 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, service entrance facilities, work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting cabling necessary to transport telephone and data (including LAN) between equipment items in a building. The horizontal system shall be wired in a star topology from the telecommunications work area to the floor distributor or campus distributor at the center or hub of the star. The backbone cabling and pathway system includes intrabuilding and interbuilding interconnecting cabling, pathway, and terminal hardware. The intrabuilding backbone provides connectivity from the floor distributors to the building distributors or to the campus distributor and from the building distributors to the campus distributor as required. The backbone system shall be wired in a star topology with the campus distributor at the center or hub of the star. The interbuilding backbone system provides connectivity between the campus distributors and is specified in Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP). Provide telecommunications pathway systems referenced herein as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications drawings; G

Telecommunications Space Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Telecommunications cabling (backbone and horizontal); G

Patch panels; G

Telecommunications outlet/connector assemblies; G

Equipment support frame; G

Connector blocks; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Telecommunications cabling testing; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Manufacturer Qualifications; G

Test plan; G

SD-09 Manufacturer's Field Reports

Factory reel tests

SD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 5; G

SD-11 Closeout Submittals

Record Documentation; G

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00 SUBMITTAL PROCEDURES, submitted plan drawings shall be a minimum of 11 by 17 inches in size using a minimum scale of 1/8 inch per foot. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Drawings

Provide registered communications distribution designer (RCDD) approved, drawings in accordance with TIA-606. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure in accordance with TIA-606. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the EF telecommunications and ER telecommunications, CD's, BD's, and FD's to the telecommunications work area outlets. Drawings provided must not be replications of the original construction documents. Replication of architectural floor plan is permitted. The following drawings shall be provided as a minimum:

- a. T1 - Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.
- b. T2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.
- c. T4 - Typical Detail Drawings - Faceplate Labeling, Firestopping, Americans with Disabilities Act (ADA), Safety, Department of Transportation (DOT). Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.

1.6.1.2 Telecommunications Space Drawings

Provide T3 drawings in accordance with TIA-606 that include telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard and wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building

protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and

copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568.1-E, TIA-568.2-D and TIA-568.3-D.

1.6.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the components and accessories for each cable type specified, 60 days prior to the proposed test date. Include procedures for certification, validation, and testing.

1.6.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements,

manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.10 MAINTENANCE

1.10.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system, Data Package 5. Submit operations and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data Package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION. Ensure that these drawings and documents depict the as-built configuration.

1.10.2 Record Documentation

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in

hard copy format Provide the following T5 drawing documentation as a minimum:

- a. Cables - A record of installed cable shall be provided in accordance with TIA-606. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with TIA-606. Include manufacture date of cable with submittal.
- b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with TIA-606. Documentation shall include the required data fields in accordance with TIA-606.

PART 2 PRODUCTS

2.1 COMPONENTS

Components shall be UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with TIA-569 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide system furniture pathways in accordance with UL 1286.

2.3 TELECOMMUNICATIONS CABLING

Cabling shall be UL listed for the application and shall comply with TIA-568.0-E, TIA-568.1-E, TIA-568.2-D, TIA-568.3-D and NFPA 70. Provide a labeling system for cabling as required by TIA-606 and UL 969. Ship cable on reels or in boxes bearing manufacture date for for unshielded twisted pair (UTP) in accordance with ICEA S-90-661 and optical fiber cables in accordance with ICEA S-83-596 for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation shall not be used.

2.3.1 Backbone Cabling

2.3.1.1 Backbone Optical Fiber

Provide in accordance with ICEA S-83-596, TIA-568.3-D, UL 1666 and NFPA 70. Cable shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 40 inches.

Provide the number of strands indicated, (but not less than 12 strands between the main telecommunication room and each of the other telecommunication rooms), of single-mode(OS2), tight buffered fiber optic cable.

Provide plenum (OFNP), riser (OFNR) fiber optic cable in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. The cable cordage jacket, fiber, unit, and group color shall be in accordance with TIA/EIA-598.

2.3.2 Horizontal Cabling

Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA-568.1-E.

2.3.2.1 Unshielded Horizontal Copper

Provide horizontal copper cable, UTP, 100 ohm in accordance with TIA-568.2-D, UL 444, ANSI/NEMA WC 66, ICEA S-90-661. Provide four each individually twisted pair, minimum size 24 AWG conductors, Category 6A, with a thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) and length marking at regular intervals in accordance with ICEA S-90-661. Provide plenum (CMP) communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. Cables installed in conduit within and under slabs shall be UL listed and labeled for wet locations in accordance with NFPA 70.

2.3.2.2 Shielded Horizontal Copper

Provide horizontal copper cable, STP (F/UTP), 100 ohm in accordance with TIA-568.2-D, UL 444, ANSI/NEMA WC 66, ICEA S-90-661. Provide four each individually twisted pair, minimum size 23 AWG conductors, Category 6A, with a thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) and length marking at regular intervals in accordance with ICEA S-90-661. Provide plenum (CMP) communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. Cables installed in conduit within and under slabs shall be UL listed and labeled for wet locations in accordance with NFPA 70.

2.4 TELECOMMUNICATIONS SPACES

Provide connecting hardware and termination equipment in the telecommunications entrance facility and telecommunication equipment rooms to facilitate installation as shown on design drawings for terminating and cross-connecting permanent cabling. Provide telecommunications interconnecting hardware color coding in accordance with TIA-606.

2.4.1 Backboards

Provide void-free, interior grade A-C plywood 3/4 inch thick 4 by 8 feet as indicated. Backboards shall be fire rated by manufacturing process. Fire stamp shall be clearly visible. Backboards shall be provided on a minimum of two adjacent walls in the telecommunication spaces.

2.4.2 Equipment Support Frame

Provide in accordance with ECIA EIA/ECA 310-E and UL 50.

- a. Cabinets, wall-mounted modular type, steel construction, minimum, powder coated black to resist corrosion. Cabinet shall have have lockable front door, side panels, ground lug, and top and bottom cable access. Cabinet shall be compatible with 19 inches panel mounting. All cabinets shall be keyed alike. A power distribution unit (PDU) as indicated on drawings. All cabinets shall be keyed alike.
- b. Cabinets, three-part, swing-out, wall-mounted, floor supported, steel construction, minimum, powder coated black to resist corrosion. Cabinet shall have have lockable front door, side panels, ground lug, and top and bottom cable access. Cabinet shall be compatible with 19 inches panel mounting. A power distribution unit (PDU) as indicated on drawings. All cabinets shall be keyed alike.
- c. Cabinets, freestanding modular type, steel construction , minimum, powder coated black to resist corrosion. Cabinet shall have removable and lockable side panels, front and rear doors, and have adjustable feet for leveling. Cabinet shall be vented in the roof and rear door. Cabinet shall have cable access in the roof and base and be compatible with 19 inches panel mounting. Provide cabinet with grounding bar. A power distribution unit (PDU) as indicated on drawings. All cabinets shall be keyed alike.

2.4.3 Connector Blocks

Provide insulation displacement connector (IDC) Type 110 for Category 6 systems. Provide blocks for the number of horizontal and backbone cables terminated on the block plus 25 percent spare.

2.4.4 Cable Guides

Provide cable guides specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on telecommunications backboards. Cable guides of ring or bracket type devicesbackboard for horizontal cable management and individually mounted for vertical cable management. Mount cable guides with screws.

2.4.5 Patch Panels

Provide ports for the number of horizontal and backbone cables terminated on the panel plus 25 percent spare. Provide pre-connectorized optical fiber patch cords for patch panel. Provide patch cords, as complete assemblies, with matching connectors as specified. Provide fiber optic patch cables with crossover orientation in accordance with TIA-568.3-D. Patch cords shall meet minimum performance requirements specified in TIA-568.3-D for cables, cable length and hardware specified.

2.4.5.1 Modular to 110 Block Patch Panel

Provide in accordance with TIA-568.1-E and TIA-568.2-D. Panels shall be third party verified and shall comply with EIA/TIA Category 6A requirements. Panel shall be constructed of steel or aluminum and shall be compatible with an ECIA EIA/ECA 310-E 19 inches equipment. Panel shall provide 48 non-keyed, 8-pin modular ports, wired to T568A. Patch panels shall terminate the building cabling on Type 110 IDCs and shall utilize a printed circuit board interface. The rear of each panel shall have incoming cable strain-relief and routing guides. Panels shall have each port factory numbered and be equipped with laminated plastic nameplates above each port. Provide patch panel with grounding provisions for foiled/shielded cable.

2.4.5.2 Fiber Optic Patch Panel

Provide panel for maintenance and cross-connecting of optical fiber cables. Panel shall be constructed of steel or aluminum minimum and shall be mounted and compatible with a ECIA EIA/ECA 310-E 19 inches equipment rack. Each panel shall provide single-mode adapters as ST in accordance with TIA/EIA-604-2 with metallic alignment sleeves and duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves. Provide dust cover for unused adapters.

2.4.6 Fiber Enclosure

Constructred of steel or aluminium with a powder coated finish. Capable of housing fiber patch panels secure to enclosure. Each enclosure shall have a cable management tray a minimum of 8 inches deep with removable cover, incoming cable strain-relief and routing guides. Provide enclosure of rack units as indicated on drawings.

2.4.6.1 DIN Rail Fiber Enclosure

Fiber enclosure constructed of steel or aluminum with a powder coated finish. Capable of housing panels secure to enclosure. Each enclosure shall have a cable management tray. Enclosure to have options for cable glands or grommets up to 1 inch. Cable gland can accomodate 0.25 inch-0.485 inch cable O.D. Enclosure capable of holding a single path panel.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

2.5.1 Outlet/Connector Copper

Outlet/connectors shall comply with FCC Part 68, TIA-568.1-E, and TIA-568.2-D. UTP outlet/connectors shall be UL 1863 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and shall be third party verified and shall comply with TIA-568.2-D Category 6 and 6A requirements. Outlet/connectors provided for UTP and STP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet/connector shall be wired T568A. UTP outlet/connectors shall comply with TIA-568.2-D for 200 mating cycles. STP Foiled/shielded outlet/connectors shall be UL 1863 listed, non-keyed 8-pin modular, constructed of thermoplastic and zinc die cast housing and third party verified and comply with TIA-568.2-D.

2.5.2 Optical Fiber Adapters(Couplers)

Provide optical fiber adapters suitable for ST in accordance with TIA/EIA-604-2 with metallic alignment sleeves and duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves. Provide dust cover for adapters. Optical fiber adapters shall comply with TIA-455-21 for 500 mating cycles.

2.5.3 Optical Fiber Connectors

Provide in accordance with TIA-455-21. Optical fiber connectors shall be ST in accordance with TIA/EIA-604-2 with metallic ferrule, epoxyless and duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves compatible with single-mode fiber. The connectors shall provide a maximum attenuation of 0.3 dB at 1310 nm with less than a 0.2 dB change after 500 mating cycles.

2.5.4 Cover Plates

Telecommunications cover plates shall comply with UL 514C, and TIA-568.1-E, TIA-568.2-D; flush design constructed of high impact thermoplastic material white in color. Provide labeling in accordance with the paragraph LABELING in this section.

2.6 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA-607, and NFPA 70. Components shall be identified as required by TIA-606. Provide ground rods, bonding conductors, and grounding busbars as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.7 FIRESTOPPING MATERIAL

Provide as specified in Section 07 84 00 FIRESTOPPING.

2.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.9 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inches thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inches high normal block style.

2.10 TESTS, INSPECTIONS, AND VERIFICATIONS

2.10.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with TIA-568.1-E, TIA-568.2-D,

TIA-568.3-D, TIA-526-7 for single mode optical fiber cables.

2.11 DIN RAIL

35MM top hat rail, galvanized in accordance with IEC/EN 60715.

2.12 ETHERNET MEDIA CONVERTER

Able to convert ethernet to single-mode fiber. Fiber output operates at 1300nm wavelength using an LED emitter and photo-detector on SC type connectors. Maximum distance of fiber transmission is 16 miles with a speed of 500kbps. Ethernet interface is to be a single RJ-45 port. Operating temperature of -68 F to 140 F. Converter is to meet standards/regulations EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, and EN61000-4-6. Unit is to have a UL 508 listing. Data transmission maximum input distortion of +- 3.5% and a max output distortion of <6.25%. Nominal supply voltage of 24 VDC with a supply range of 18VDC to 32VDC. Unit must be able to be mounted to a 35mm DIN rail.

2.12.1 Ethernet Media Converter Power Supply

Power supply must be capable of mounting to a 35mm DIN rail system. Input voltage of 120VAC with an output voltage of 24VDC. Maximum power output of 60W.

PART 3 EXECUTION

3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with NECA/BICSI 568, TIA-568.1-E, TIA-568.2-D, TIA-568.3-D, TIA-569, NFPA 70, and UL standards as applicable. Provide cabling in a star topology network. Pathways and outlet boxes shall be installed as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling. Cabling shall be run with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

3.1.1 Cabling

Install UTP, STP, and optical fiber telecommunications cabling system as detailed in TIA-568.1-E, TIA-568.2-D, TIA-568.3-D. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.

3.1.1.1 Backbone Cable

- a. Optical fiber Backbone Cable. Install intrabuilding backbone optical fiber in indicated pathways. Do not exceed manufacturer's recommended bending radii and pull tension. Prepare cable for pulling by cutting outer jacket 10 inches leaving strength members exposed for approximately 10 inches. Twist strength members together and attach to pulling eye. Vertical cable support intervals shall be in accordance with manufacturer's recommendations.

3.1.1.2 Horizontal Cabling

Install horizontal cabling as indicated on drawings. Do not untwist Category 6A UTP and 6A STP cables more than one half inch from the point of termination to maintain cable geometry. Provide slack cable in the form of a figure eight (not a service loop) on each end of the cable, 10 feet in the telecommunications room, and 12 inches in the work area outlet.

3.1.2 Pathway Installations

Provide in accordance with TIA-569 and NFPA 70. Provide building pathway as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.3 Service Entrance Conduit, Underground

Provide service entrance underground as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.4 Cable Tray Installation

Install cable tray as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Only CMP and OFNP type cable shall be installed in a plenum.

3.1.5 Work Area Outlets

3.1.5.1 Terminations

Terminate UTP and STP cable in accordance with TIA-568.1-E, TIA-568.2-D and wiring configuration as specified. Terminate fiber optic cables in accordance with TIA-568.3-D

3.1.5.2 Cover Plates

As a minimum, each outlet/connector shall be labeled as to its function and a unique number to identify cable link in accordance with the paragraph LABELING in this section.

3.1.5.3 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 12 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturer's bend radius for each type of cable shall not be exceeded.

3.1.5.4 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

3.1.6 Telecommunications Space Termination

Install termination hardware required for Category 6A, and optical fiber system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

3.1.6.1 Connector Blocks

Connector blocks shall be wall mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Install in accordance with industry standard wire routing guides in accordance with TIA-569.

3.1.6.2 Patch Panels

Patch panels shall be mounted in equipment cabinets racks with sufficient ports to accommodate the installed cable plant plus 25 percent spares.

- a. Copper Patch Panel. Copper cable entering a patch panel shall be secured to the panel with cable ties to prevent movement of the cable.
- b. Fiber Optic Patch Panel. Fiber optic cable loop shall be 3 feet in length. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.6.3 Equipment Support Frames

Install in accordance with TIA-569:

- a. Racks, floor mounted modular type. Permanently anchor rack to the floor in accordance with manufacturer's recommendations.
- b. Cabinets, wall-mounted modular type. Mount cabinet to plywood backboard in accordance with manufacturer's recommendations. Mount cabinet so height of highest panel does not exceed 78 inches above floor.

3.1.7 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified in Section 07 84 00 FIRESTOPPING.

3.1.8 Grounding and Bonding

Provide in accordance with TIA-607, NFPA 70 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.2 LABELING

3.2.1 Labels

Provide labeling in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using thermal ink transfer process.

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA-606.

3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with TIA-606.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3.1 Painting Backboards

If backboards are required to be painted, then the manufactured fire retardant backboard must be painted with fire retardant paint, so as not to increase flame spread and smoke density and must be appropriately labeled. Label and fire rating stamp must be unpainted.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 TESTING

3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568.1-E, TIA-568.2-D, TIA-568.3-D.

Test equipment shall conform to TIA-1152. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.

3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568.1-E, TIA-568.2-D, TIA-568.3-D. Visually confirm Category 6A, marking of outlets, cover plates, outlet/connectors, and patch panels.

3.5.1.2 Verification Tests

For single-mode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568.3-D and TIA-526-7 using Method B, OTDR for single-mode optical fiber. Perform verification acceptance tests.

3.5.1.3 Performance Tests

Perform testing for each outlet and MUTOA as follows:

3.5.1.4 Final Verification Tests

Perform verification tests for UTP and optical fiber systems after the complete telecommunications cabling and workstation outlet/connectors are installed.

- a. Voice Tests. These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and DSN telephone call.
- b. Data Tests. These tests assume the Information Technology Staff has a network installed and are available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

-- End of Section --

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SECTION 27 32 50.00 22

ELEVATOR LANDING TWO-WAY COMMUNICATION SYSTEM

7/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2021) Life Safety Code

NFPA 170 (2021) Standard for Fire Safety and
Emergency Symbols

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 72 (2022) National Fire Alarm and Signaling
Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-520-01 (2015; with Change 2, 2021) Interior
Electrical Systems

UNDERWRITERS LABORATORIES (UL)

UL 2525 (2020) UL Standard for Safety for Two-Way
Emergency Communications Systems for
Rescue Assistance

1.2 RELATED SECTIONS

- a. Section 07 84 00 FIRESTOPPING for additional work related to firestopping.
- b. Section 09 90 00 PAINTS AND COATINGS
- c. Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE

1.3 SUMMARY

1.3.1 Scope

Provide a two-way communication system at each elevator landing other than the level of egress discharge to provide a means of communication for occupants requiring rescue assistance and conforming to NFPA 70, NFPA 101, ICC IBC and UL 2525.

The two-way communication system must provide communication between the elevator landing and a central control point that is approved by the Authority Having Jurisdiction. The two-way communication system includes a Base / Master Station, Remote Communication Stations (Call Boxes), Primary and Secondary Power Supply, and Signage. The two-way communication system must include both audible and visible signals. Location of the two-way communication system call boxes must be identified by signage. Instructions for summoning assistance via the two-way communication system must be posted adjacent to the call boxes.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Partial submittals and submittals not reviewed by the Qualified Professional Engineer (QPE) will be returned disapproved without review. Shop drawings (SD-02), product data (SD-03) and Design Data (SD-05) must be combined and submitted as one complete package. The QPE must review the SD-02/SD-03/SD-05 submittal package for completeness and compliance with the Contract provisions prior to submission to the Government. The QPE must provide a Letter of Confirmation that they have reviewed the submittal package for compliance with the contract provisions. This letter must include their registered professional engineer stamp and signature. Partial submittals and submittals not reviewed by the QPE will be returned by the Government disapproved without review. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Nameplates; G

Wiring Diagrams; G

System Layout; G

Identifying And Instructional Signage; G

SD-03 Product Data

Technical Data And Computer Software; G

Base / Master Station; G

Power Supply; G

Call Boxes; G

Cabling And Wiring; G

SD-06 Test Reports

Field Quality Control; G

Testing Procedures; G

SD-07 Certificates

Installer; G

Qualified Professional Engineer (Qpe); G

Request For Inspection And Tests; G

Testing; G

Instructor; G

SD-10 Operation and Maintenance Data

Operation And Maintenance (O&M) Instructions; G

SD-11 Closeout Submittals

As-Built Drawings; G

1.5 QUALITY ASSURANCE

Equipment and devices must not impair reliability or operational functions of other systems.

Interpret reference to Authority Having Jurisdiction to mean the Contracting Officers Designated Representative (COR).

The recommended practices stated in the manufacturers literature or documentation are considered as mandatory requirements.

Devices and equipment must be listed by UL Listed or approved by FM APP GUIDE.

Obtain two-way communication equipment and system from a single manufacturer.

1.5.1 Submittal Documents

1.5.1.1 Preconstruction Submittals

Within 36 days of contract award but not less than 14 days prior to commencing any work on site, the Contractor must submit the following for review and approval. SD-02, SD-03 and SD-05 submittals received prior to the review and approval of the qualifications of the QPE will be returned disapproved without review. All resultant delays must be the sole responsibility of the Contractor.

1.5.1.1.1 Shop Drawings

Shop drawings must not be smaller than ANSI D. Drawings must comply with the requirements of NFPA 72 and NFPA 170. Minimum scale for floor plans

must be 1/8 inch = 1 foot. Include, in table format on the drawings, manufacturer's name, model, voltage, and catalog numbers for equipment and components

1.5.1.1.1.1 Nameplates

Include nameplate illustrations and data on the shop drawings to obtain Government approval before installation.

1.5.1.1.1.2 Wiring Diagrams

Three copies of point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between the equipment or systems that are supervised or controlled by the system. Diagrams must show connections from field devices to the Base / Master Station. Point-to-point wiring diagrams must be job specific and must not indicate connections or circuits not being utilized. Provide complete riser diagrams indicating the wiring sequence of all devices and their connections to the control equipment. Include a color-code schedule for the wiring. Provide internal control cabinet drawings showing internal block diagram connections.

1.5.1.1.1.3 System Layout

Submit shop drawings showing layout, profiles and product components, including anchorage and accessories. Include cabling and wiring diagrams, call station and Base / Master Station installation details, and equipment cabinet details.

1.5.1.1.1.4 Identifying and Instructional Signage

Call Box Instructional Sign: Submit shop drawings showing sign locations, mounting details, size, manufacturer model numbers, project specific sign text, font dimensions, and colors.

1.5.1.1.2 Product Data

Provide annotated data sheets to show the specific model, type, and size of each item. Catalog cuts must also indicate the NRTL listing. The data must be highlighted to show model, size, and options that are intended for consideration. Include Manufacturer's installation instructions. Data must be adequate to demonstrate compliance with all contract requirements. Product data for all equipment must be combined into a single submittal. Provide UL or FM listing cards for all equipment.

1.5.1.1.2.1 Technical Data and Computer Software

Technical data and computer software (meaning technical data that relates to computer software) that are specifically identified in this project, and may be defined/required in other specifications, must be delivered, strictly in accordance with the CONTRACT CLAUSES. Identify data delivered by reference to the particular specification paragraph against which it is furnished. Data to be submitted must include complete system, equipment, and software descriptions. Descriptions must show how the equipment will operate as a system to meet the performance requirements of this contract. The data package must also include the following:

- a. Identification of programmable portions of system equipment and

capabilities.

- b. Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.
- c. Provision of operational software data on all modes of programmable portions of the system.
- d. Description of equipment operation.
- e. Description of auxiliary and remote equipment operations.
- f. Library of application software.
- g. Operation and maintenance manuals.

1.5.1.1.3 Design Data

Submit system battery calculations utilizing the current draw for 4 hours talk time at all Call Boxes. Calculations including ampere-hour requirements for each system component and each control unit component, and the battery recharging period, must be included on the drawings. The calculations must be in tabular format.

The maximum recharging period is 48 hours.

1.5.1.2 Test Reports

1.5.1.2.1 Field Quality Control Test Report

Submit certified test reports showing compliance with specified performance characteristics.

1.5.1.2.2 Testing Procedures

Submit detailed test procedures for the system 30 days prior to performing system tests.

1.5.1.3 Certificates

1.5.1.3.1 Installer Certificates

Submit Installer certificates prior to commencement of installation.

1.5.1.3.2 Qualified Professional Engineer (QPE) Certificates

Submit QPE certificates prior to design submittals.

1.5.1.3.3 Request for Inspection and Tests

Submit the request for final testing at least 15 calendar days prior to the test date.

1.5.1.3.4 Testing Certificates

Submit Pre-Government test certificates and documentation after completion of testing. Certificates and documentation must be re-submitted after final acceptance testing when final acceptance test results differ from pre-government test results.

1.5.1.4 Closeout Submittals

1.5.1.4.1 Operation and Maintenance (O&M) Instructions

Following acceptance of the system, submit O&M data in accordance with in accordance with section 01 78 23 OPERATION AND MAINTENANCE DATA and section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI).

1.5.1.4.2 As-built Drawings

Within two weeks of system acceptance, submit as-built drawings for review and acceptance.

1.5.2 Design Services

Design of the system must be coordinated with manufacturer requirements under the supervision of a Qualified Professional Engineer (PE). The QPE must review and sign the shop drawings prior to submittal to the Government.

1.5.3 Installer

System installer with a minimum of two years of experience utilized to assist in the installation of two-way communication or similar systems. An electrician will be allowed to install wire, cable, conduit and backboxes for the system. The installer must be trained by the manufacturer in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.5.4 Manufacturer's Representative

The Manufacturer's Representative must be an employee of the manufacturer with necessary technical training on the system being installed. Alternatively, the Manufacturer's Representative will be permitted to be an employee of the Contractor that has been certified by the manufacturer and must provide copies of this certification bearing the certified individuals name with the shop drawings.

1.5.5 Manufacturer

Components must be of current design and must be in regular and recurrent production at the time of installation. Provide design, materials, and devices for a complete system, conforming to NFPA 72, manufacturer's requirements, and the contract documents.

1.5.6 Qualified Professional Engineer (QPE)

The Qualified Professional Engineer (QPE) must be a U.S. Registered Engineer (QPE) and be an integral part of the Prime Contractor's Quality Control Organization. This QPE cannot have any business relationships (owner, partner, operating officer, distributor, salesman, or technical representative) with any equipment device manufacturers, suppliers or installers for any such equipment provided as part of this project.

1.5.7 Regulatory Requirements

The emergency communication hardware must comply with the ABA

Accessibility Standards, NFPA 70, NFPA 101, ICC IBC and UL 2525.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants.

1.7 WARRANTY

All materials and installation must be guaranteed to be free of defects in material and workmanship for one year after final acceptance of installation and tests.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials, equipment, and devices that have been tested by a nationally recognized testing laboratory, such as UL or FM Approvals, LLC (FM), and listed or approved for service when so required by NFPA 72 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for any particular classification of materials. Material and equipment must be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least five years prior to bid opening.

2.2 NAMEPLATES

Major components, including Base / Master Station, Control Equipment, and Power Supplies, must have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment.

2.3 KEYS

If provided, keys and locks for equipment must be identical. Provide not less than six keys. Base / Master Station is not permitted to be locked or lockable.

2.4 SYSTEM COMPONENTS

2.4.1 Base / Master Station

- a. The Base / Master Station is to be located as shown on the drawings at a central control point on the first floor or as determined by Authority Having Jurisdiction.
- b. The Base / Master Station must have a stainless steel or powder coated steel semi-recessed or recessed housing.
- c. The Base / Master Station must provide an audible and visual indicator that a Call Box has been activated.
- d. Include a handset with a black coil cord and hands free speakerphone to communicate back to the Call Boxes. Provide hand free two-way communication via a single operation Push To Talk (PTT) button on the faceplate of the panel and an integral speaker within the panel flush mounted in the faceplate for communication with all call boxes.

- e. The Base / Master Station must include wording identifying the location of each Call Box and light an LED when a particular Call Box has been activated. When the call station switch is activated, a red LED button must illuminate and a single tone sounds.
- f. The Base / Master Station must allow rescue personnel to speak to all Call Boxes or individual Call Boxes. The Base / Master Station must indicate light and tone signals from multiple remote call stations.
- g. When a Call Box signal is acknowledged at the Base / Master Station, the remote call station is signaled with a flashing light and a single tone.
- h. The Base / Master Station must be 24 vdc or 120 vac powered and include a rechargeable battery to maintain backup power for a minimum of 4 hours of talk time. The back-up power supply must be capable of supplying power all Call Boxes and the Base / Master Station, under simultaneous operation. Separate back-up battery sources may be provided for Call Boxes.
- i. If the Base / Master Station is not at a constantly attended location, the master control unit must have a timed automatic communications capability to connect with an off-site constantly attended monitoring location approved by the authority having jurisdiction, where trained personnel can initiate the appropriate response. In the event of an off-site connection, a signal must be transmitted to the off-site monitoring location, identifying the specific building prior to initiating the live voice two-way communication. The automatic communications capability must be automatic and continuous with re-programming initiated by password protected access by authorized personnel. The Base / Master Station must provide visible and audible signals when the off-site phone number is not programmed or deleted.

2.4.2 Remote Communications Stations (Call Boxes)

- a. Call Boxes are to be located on all floors above the first floor, next to the elevator landing as shown on the drawings.
- b. The Call Boxes must have the ability to be programmed with up to 5 emergency phone numbers (Base / Master Station and one off-site). Upon activation of the emergency push button, a call will be automatically placed to the Base / Master Station. If no one answers at the Station, the Call Box must dial a secondary location outside the building to activate two-way off-site person to person voice communications via landline, cellular device, or voice over internet protocol (VOIP). The programming of emergency phone numbers must be programmed or re-programmed by password protected access by authorized personnel.
- c. The Call Boxes must be in full compliance with ABA requirements and include a vandal resistant speakerphone.
- d. Call Boxes must have a hands-free speakerphone and be a push-button-once to talk system with an LED to indicate status of call. The Call Box must have a red LED that will light up upon push of the button. The light must be a solid color when the Call Box is activated and will flash when call has been answered.

- e. The Call Boxes must allow the programming of a specific location message of the unit. This allows rescue personnel to know the location of the activated Call Box. The Call Box must have a minimum 18 second recordable message capability, programmable to play 1 or 2 times. The Call Box must notify called party of the location of the call upon being received at the emergency dispatch center. The Call Box must be capable of allowing the called party to replay the location message if necessary to ensure an understanding of the caller location. Once a call has been made (button pushed), the call can only be terminated by the called party.
- f. The Call Boxes are to be located no higher than 48 inches, measured to the center of the button above ground or floor level.
- g. The Call Boxes must have a Braille face plate. The Call Box operating instructions must include Emergency Phone, International Phone Symbol and raised Braille lettering.
- h. The Call Boxes are to be wall, flush mounted.
- i. The Call Boxes must incorporate heavy duty switches and speakers along with stainless steel plates and tamper-proof screws.
- j. The Call Boxes are to be powered by the Base / Master Station Control Unit.
- k. The Call Box must be capable of being programmed and re-programmed on-site.
- l. Call boxes must have a Listed operating temperature of between -40 deg F to +150 deg F.
- m. Call boxes must have EEPROM memory to protect programming.

2.4.3 Power Supply

The 120vac Power Supply must be capable of supplying power to the Base / Master Station Control Unit.

2.4.4 Cabling and Wiring

Wiring types and sizes must be in accordance with UFC 3-520-01 and manufacturer's requirements.

The two-way communication systems must have a pathway survivability of level 2 or level 3 as defined in NFPA 72. Level 1 is permitted when the building is less than 2-hour fire rated construction.

The Call Boxes and the Base / Master Station control unit must communicate with each other via pathways based on their performance capabilities under abnormal (fault) conditions in accordance with the requirements for Class A, Class B, Class N, or Class X.

Wiring must be installed in metallic conduit raceways throughout the building. Conduit must be 1/2 inch minimum. The use of flexible conduit is not permitted.

2.4.5 System Integrity and Power Monitoring

Provide monitoring of the system integrity per NFPA 72 via the fire alarm system. Provide supervision of all circuit integrity and power monitoring. Connect to the fire alarm system via a fire alarm system addressable monitor module.

2.5 ELECTRICAL POWER

2.5.1 Primary Power

Provide primary power for the system from the dedicated emergency panel, which also serves the fire alarm equipment that is powered from a lock-on breaker from the primary electrical service equipment.

2.5.2 Secondary Power

Provide battery backup that provides power for a minimum of 4 hours talk time. Battery sizes must be determined by calculations and must be as required by the manufacturer with a 20 percent safety margin. Batteries must comply with manufacturer requirements.

The Base / Master Station must have a built-in battery backup and include a rechargeable battery to maintain backup power for a minimum of 4 hours of talk time.

Call Boxes must have battery backup supplied by the Base / Master Station or individually. Include rechargeable batteries to maintain backup power for a minimum of 4 hours of talk time.

2.5.3 Batteries

Provide sealed, maintenance-free, sealed lead acid batteries as the source for emergency power to the Base / Master Station and Call Boxes. Batteries must contain suspended electrolyte. The battery system must be maintained in a fully charged condition by means of a solid state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.

2.6 SIGNAGE

Directions for the use of the two-way communication system, instructions for summoning assistance via the two-way communication system, and written identification of the location must be posted adjacent to the two-way communication system. Each Elevator landing location must include a Call Box Instructional Sign. Instructions for system use must be provided for the Base / Master Station.

2.6.1 Call Box Instructional Signs

- a. A sign with written instructions on the use of the Call Box under emergency conditions must be posted next to each Call Box. The instructions must include all of the following:
- b. Direct persons able to use the exit stairway do so as soon as possible, unless they are assisting others.
- c. Information on planned availability of assistance in the use of stairs or supervised operation of elevators how to summon such assistance.

- d. Directions for use of the two-way communications system.
- e. The Call Box instructional signs must include black letters with contrasting background.
- f. The Call Box instructional signs must have nominal dimensions not less than 8-inches high by 6-inches wide.
- g. The Call Box Instructional sign must include "EMRGENCY COMMUNICATIONS" and written identification of the location in tactile and Braille.
- h. The Call Box Instruction signs must be mounted next to the Call Box at the elevator landing in accordance with the Architectural Barriers Act Standards.

2.6.2 Base / Master Station Instructions

Provide a typeset printed or typewritten instruction card mounted inside the Base / Master Station enclosure or mounted on the wall with a Lexan plastic or glass cover in a stainless steel or aluminum frame. The card must show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions. The instructions must be approved by the Contracting Officer's Designated Representative before being posted.

The instructions must include the off-site monitoring location telephone number.

The instructions must be typewritten, minimum 12 point font with black lettering and white background.

PART 3 EXECUTION

3.1 SYSTEM FIELD WIRING

3.1.1 Wiring within Cabinets, Enclosures, and Boxes

Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Wiring must conform to NFPA 70. Conductors must not be spliced or otherwise interrupted. The use of wire nuts or similar devices is prohibited. Indicate the following in the wiring diagrams:

- a. Point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system. Diagrams must show connections from field devices to the control equipment.
- b. Complete riser diagrams indicating the wiring sequence of devices and their connections to the control equipment. Include a color code schedule for the wiring. Include floor plans showing the locations of devices and equipment.

3.1.2 System Wiring

Voltages must not be mixed in any junction box, housing, or device except those containing power supplies and control relays. Provide all wiring in electrical metallic conduit. Conceal conduit in finished areas. The use

of flexible conduit is not permitted. Run conduit or tubing (rigid, IMC, EMT, FMC, etc.) as permitted by UFC 3-520-01, NFPA 72 and NFPA 70 concealed unless specifically indicated otherwise.

3.1.3 Conductor Terminations

Labeling of conductors at terminal cabinets must be provided at each conductor connection. Each conductor or cable must have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet must contain a laminated drawing that indicates each conductor, its label, circuit, and terminal. The laminated drawing must be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals.

3.2 FIRESTOPPING

Provide firestopping for holes at conduit penetrations through floor slabs, fire rated walls, partitions with fire rated doors, corridor walls, and vertical service shafts in accordance with Section 07 84 00 FIRESTOPPING.

3.3 PAINTING

Paint exposed electrical and system conduit, junction boxes, back boxes and cover plates to match adjacent finishes in exposed areas. In unfinished areas, including areas above ceilings, conduit, junction boxes, back boxes and cover plates must be factory painted red. All painting must comply with Section 09 90 00 PAINTS AND COATINGS.

3.4 FIELD QUALITY CONTROL

3.4.1 Testing Procedures

The test procedures must be based on manufacturer's requirements, prepared and signed by the QPE and signed by the Manufacturer's Representative. Detailed test procedures must list all components of the installed system and circuits. Test procedures must include sequence of testing, time estimate for each test, and sample test data forms. The test data forms must be in a check-off format (pass/fail) with space to add applicable test data, and must be used for the pre-government testing and the final acceptance testing. Testing must follow all manufacturer recommended testing procedures.

3.4.2 Pre-Government Testing

Conduct inspections and tests to ensure that devices and circuits are functioning properly. After pre-government testing is complete, the QPE must provide a letter certifying that the installation is complete and fully operable. The letter must state that each Call Box was tested in place and functioned properly. The letter must also state that Base / Master Station functions were tested and operated properly. The letter must include the names and titles of the witnesses to the pre-government tests. The Contractor and an authorized representative of the equipment supplier must be in attendance at the pre-government testing to make necessary adjustments. The pre-government tests must be witnessed by the QPE.

3.4.3 Final Testing

Notify the Contracting Officer in writing when the system is ready for final acceptance testing. When pre-government tests have been completed and corrections made, submit a signed, dated certificate with a request for final inspection and tests to the Contracting Officers Designated Representative (COR). Submit the request for final testing after Government approval of pre-government test reports and at least 15 calendar days prior to the test date. The tests must be performed in accordance with the approved test procedures in the presence of the Contracting Officer. Furnish instruments and personnel required for the tests. A final acceptance test will not be scheduled until the following are provided at the job site:

- a. The systems manufacturer's technical representative.
- b. Marked-up red line drawings of the system as actually installed. The final tests will be witnessed by the QPE and the Contracting Officers Designated Representative (COR). At this time, any and all required tests must be repeated at their discretion.

3.4.4 System Acceptance

Following acceptance of the system, as-built drawings and O&M manuals must be delivered to the Contracting Officer for review and acceptance. Submit six sets of detailed as-built drawings. The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings must be provided at the time of, or prior to, the final acceptance test.

- a. Furnish one set of full size paper as-built drawings and schematics. The drawings must be prepared on uniform sized mylar sheets not less than ANSI D (22 inches x 34 inches) title block similar to contract drawings. Furnish one set of CDs or DVDs containing software back-up and CAD based drawings in latest version of AutoCAD, DXF, and PDF format of as-built drawings and schematics.
- b. Include complete wiring diagrams showing connections between devices and equipment, both factory and field wired.
- c. Include complete wiring diagrams showing connections between devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as-built location of devices and equipment.

3.4.5 Minimum System Tests

- a. Verify that final connections to the system are made by a factory technician authorized by the manufacturer of the products installed.
- b. Demonstrate operation of the complete system and each major component.
- c. Perform a complete functional test of the system.
- d. Perform all testing required by the manufacturer.

3.5 INSTRUCTION OF GOVERNMENT EMPLOYEES

3.5.1 Instructor

Include in the project the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided. The instructor must train the Government employees designated by the Contracting Officer, in the care, adjustment, maintenance, and operation of the system. The instructor must be thoroughly familiar with all parts of this installation. The instructor must be trained in operating theory as well as in practical O&M work. Submit the instructor's information and qualifications including the training history.

3.5.2 Required Instruction Time

Provide 8 hours of instruction after final acceptance of the system. The instruction must be given during regular working hours in two 4 hour sessions to accommodate shift workers on such dates and times identified by the Contracting Officer. The instruction may be divided into two or more periods at the discretion of the Contracting Officer. The training must allow for rescheduling for unforeseen maintenance and/or fire department responses.

The training sessions must be broken into segments that will:

- a. Facilitate the training of the system users in system operation and functionality.
- b. Facilitate the training of personnel in the programming, inspection, testing and maintenance of the system.

Operating manuals and user's guides must be provided at the time of training.

3.6 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

Submit operation and maintenance data for installed products in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI).

Submit 6 copies of the Operation and Maintenance Instructions, indexed and in booklet form. The Operation and Maintenance Instructions must be a single volume or in separate volumes and may be submitted as a Technical Data Package. Manuals must be approved prior to training. The elevator landing Two-Way Communication System Operation and Maintenance Instructions must include:

- a. "Manufacturer Data Package 5" as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA.
- b. Operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual must include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features.
- c. Maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals must

include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed.

- d. The manuals must include complete procedures for system revision and expansion, detailing both equipment and software requirements.
- e. Software delivered for this project must be provided, on each type of CD/DVD media utilized.
- f. Printouts of configuration settings for all devices.
- g. Routine maintenance checklist. The routine maintenance checklist must be arranged in a columnar format. The first column must list all installed devices, the second column must state the maintenance activity or state no maintenance required, the third column must state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

3.7 EXTRA MATERIALS

3.7.1 Repair Service/Replacement Parts

Repair services and replacement parts for the system must be available for a period of 10 years after the date of final acceptance of this work by the Contracting Officer. During the warranty period, the service technician must be on-site within 24 hours after notification. All repairs must be completed within 24 hours of arrival on-site.

During the warranty period, the installing contractor is responsible for conducting all required testing and maintenance in accordance with the requirements and recommended practices of NFPA 72 and the system manufacturer. The Installing contractor is NOT responsible for any damage resulting from abuse, misuse, or neglect of equipment by the end user.

3.7.2 Interchangeable Parts

Spare parts furnished must be directly interchangeable with the corresponding components of the installed system. Spare parts must be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts must be delivered to the Contracting Officer at the time of the final acceptance testing.

3.7.3 Spare Parts

Furnish the following spare parts and accessories:

- a. Two Call Box Instructional Signs

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment must be furnished to the Contracting Officer.

-- End of Section --

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SECTION 28 08 10

ELECTRONIC SECURITY SYSTEM ACCEPTANCE TESTING
05/16

PART 1 GENERAL

1.1 SUMMARY

This specification defines the process and procedures for initial acceptance testing of electronic security systems (ESS) to include intrusion detection, access control and video as well as associated power and communications. Requirements to plan, conduct, and document all testing activities are covered along with the Government responsibility to witness testing and review and approve submittals. During the course of the acceptance test, demonstrate that, without exception, the completed and integrated ESS complies with the contract requirements.

1.2 DEFINITIONS

The Government Representative is a qualified individual given specific authority to witness system acceptance testing and evaluate the results.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05 Design Data

Test Plan; G

SD-06 Test Reports

Draft Test Report

Final Test Report; G

SD-07 Certificates

Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 General

The Test Director, Operator, and Technician must have prior experience with the specific equipment, hardware and software installed under the contract.

1.4.1.2 Test Director

The Test Director must have at least five years of hands-on ESS experience to include any combination of design, installation, testing and maintenance.

1.4.1.3 Operator

The Operator must have at least two years of hands-on experience installing and maintaining ESS workstations to include both hardware and software. The Operator must be capable of demonstrating all workstation features and capabilities.

1.4.1.4 Technician

The technician must have at least two years of hands-on experience installing and maintaining ESS field equipment to include sensors, card readers, cameras, local processors, and communications equipment. The Technician must be capable of demonstrating all features and capabilities of ESS field equipment. Qualifications may be met by the individual experience of one technician or by the combined experience of a team of technicians.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TEST PLAN

Clearly establish the scope for ESS testing prior to beginning testing. Submit a Test Plan that addresses the following topics:

3.1.1 Personnel

Identify the Test Director, Operator, Technician, and any other personnel that will be performing test activities.

3.1.2 Equipment

List all equipment that is required to support testing. State the purpose of each piece of equipment. Describe equipment that will be used to enable voice communications between the monitoring location and the field.

3.1.3 Procedures

Provide a step-by-step procedure for conducting each functional test. Describe actions and expected results. Ensure that functional test procedures address performance standards described in contract specifications.

Download example procedures from <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic> and review for applicability and completeness. Adapt example procedures to meet specific project requirements and develop additional ones as needed. Follow TEST-MASTERTP0023-005 for Air Force projects.

3.1.4 Special Provisions

Discuss any special test provisions such as facility access, safety, integration with existing systems, and coordination with other work.

3.1.5 Test Logs

Provide logs for recording all data from functional testing and burn-in testing.

Download example logs from <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic> and review for applicability and completeness. Adapt example logs to meet specific project requirements and develop additional ones as needed.

3.1.6 Schedule

Provide an overall schedule that includes all testing milestones.

3.2 PRE-ACCEPTANCE TESTING

Conduct a complete test of all field equipment, workstations, and central system hardware and software in accordance with the approved Test Plan. The Test Director must be on site to conduct a pre-test inspection and oversee all testing activities. Prior to testing, visually inspect all ESS components and correct workmanship and neatness deficiencies as needed. During the pre-test inspection, verify the accuracy of redline drawings and update drawings as needed. Conduct testing in two phases - functional testing followed by burn-in testing.

3.2.1 Phased Testing

3.2.1.1 Functional Testing Phase

During the functional testing phase, verify system performance in accordance with approved Test Plan. Record results in approved Test Logs, and provide a written explanation of each failure to include cause, corrective action, and retest result. Continue functional testing until all tests have been successfully completed with no unresolved failures.

3.2.1.2 Burn-In Testing Phase

Begin burn-in testing after successful completion of all functional testing. During the burn-in testing phase, place the ESS in normal operating mode and evaluate system performance for a continuous 24-hour period. During this time, the ESS must be fully functional and programmed such that all features can be exercised and evaluated through normal use. Record all system anomalies in approved Test Logs. Include a description of each anomaly along with any actions taken in response. Immediately correct minor deficiencies observed during the course of testing and continue with burn-in testing. Determine the root cause of any failures and make necessary repairs or modifications to restore full functionality. After a failure is corrected repeat functional tests for components and features associated with the failure, and repeat the entire burn-in testing phase.

3.2.2 Draft Test Report

Prepare and submit a Draft Test Report detailing the results of the

testing. Refer to paragraph FINAL TEST REPORT for required content. Include a cover letter signed by the Test Director stating that pre-acceptance testing has been completed and that the system is ready for acceptance testing.

3.3 SYSTEM ACCEPTANCE

Test the ESS in accordance with the approved Test Plan in the presence of the Government Representative to certify acceptable performance. Verify that the total system meets all requirements of the specification and complies with the specified standards.

Begin acceptance testing upon arrival of the Government Representative at the project site. Place the ESS in normal operating mode and evaluate system performance during the testing period. Immediately report any deficiencies observed during testing to the Government Representative and discuss possible causes and corrective measures. Obtain Government approval prior to making any adjustments, repairs or modifications. The Government retains the right to terminate testing at any time the ESS is found to be incomplete or fails to perform as specified. Such termination of acceptance testing constitutes a FAILED system acceptance test.

3.3.1 Preparation

Notify the Contracting Officer of system readiness 15 days prior to the expected start date of acceptance testing. Prior to acceptance testing, complete all clean-up and patch work requirements. Ensure that security equipment closets and similar areas are free of accumulation of waste materials or rubbish caused by prior installation work.

3.3.2 Personnel

Ensure that the following personnel are on site to perform test activities: Test Director, Operator, Technician. Ensure that the Quality Control Manager is on site during acceptance testing.

3.3.3 Visual Inspection

Assist the Government Representative in conducting a visual inspection of ESS equipment and wiring. This inspection will focus on the general neatness and quality of workmanship and compliance with applicable codes and manufacturers' recommended installation methods. Provide a comprehensive listing of installed equipment and software along with a complete set of ESS red line drawings to be used during the inspection. Document deficiencies identified during the inspection.

3.3.4 Functional Testing

Comply with requests from the Government Representative to repeat functional tests performed previously during pre-acceptance testing. The Government reserves the right to request the Contractor to repeat all functional tests or a representative sampling thereof as a means of performance verification. Add all test results to approved Test Logs.

3.3.5 System Activity Reports

Retrieve archived data from the system and provide activity reports as requested by the Government Representative. Reports may address any type of activity to include alarms, portal transactions, and video archives.

Assist with analyzing reports to identify trends and anomalies.

3.3.6 Corrective Actions

Correct any deficiencies in coordination with the Government Representative. Maintain a punch list and review status at the end of each day. Work diligently to complete corrective actions the same day that deficiencies are observed. Add deficiencies not corrected on the same day to the rework items list maintained by the Quality Control Manager. Failure to resolve punch list items to the satisfaction of the Government constitutes a FAILED system acceptance test.

3.4 FINAL TEST REPORT

Submit a Final Test Report following the successful completion of acceptance testing to include resolution of all punch list items. Address the following topics in the Final Test Report:

3.4.1 Summary

Provide a chronological summary of all testing. Describe test activities and results in narrative form.

3.4.2 Personnel

Provide a list of all Contractor and Government personnel who participated in the testing.

3.4.3 Test Logs

Provide all completed test logs along with a test log verification signed by the Test Director.

-- End of Section --

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SECTION 28 10 05

ELECTRONIC SECURITY SYSTEMS (ESS)
05/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3	(2018) Ethernet
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ANSI ISO/IEC 7816	(R 2009) Identification Cards - Integrated Circuit Cards
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
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NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST FIPS 140-3	(2019) Security Requirements for Cryptographic Modules
NIST FIPS 201-2	(2013) Personal Identity Verification (PIV) of Federal Employees and Contractors

OPEN NETWORK VIDEO INTERFACE FORUM (ONVIF)

ONVIF	(2017) Core Specification Version 17.06
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SECRETARY OF THE NAVY

SECNAVINST 5510.36B	(2019) Department of the Navy Security Program
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TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-222	(2018H; Add 1 2019) Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures
TIA-568-C.2	(2009; Errata 2010; Add 2 2014; Add 1 2016) Balanced Twisted-Pair Telecommunications Cabling and Components Standards

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices
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UNDERWRITERS LABORATORIES (UL)

UL 294	(2018; Reprint Oct 2018) UL Standard for Safety Access Control System Units
UL 437	(2013; Reprint Oct 2017) UL Standard for Safety Key Locks
UL 508	(2018; Reprint Jul 2021) UL Standard for Safety Industrial Control Equipment
UL 634	(2007; Reprint Mar 2015) Connectors and Switches for Use with Burglar-Alarm Systems
UL 681	(2014) Installation and Classification of Burglar and Holdup Alarm Systems
UL 796	(2016) UL Standard for Safety Printed-Wiring Boards
UL 1037	(2016; Reprint Sep 2017) UL Standard for Safety Antitheft Alarms and Devices
UL 1076	(2018) UL Standard for Safety Proprietary Burglar Alarm Units and Systems

UL 1610

(2016) UL Standard for Safety
Central-Station Burglar-Alarm Units

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

ESS Components; G

Overall System Schematic; G

SD-03 Product Data

Premise Control Unit; G

Detection Sensors; G

Access Control Unit; G

Access Control Devices; G

Cameras; G

Video Recording; G

Communications Interface Devices; G

Network Switch; G

Media Converter Chassis; G

Chassis Media Converter; G

Camera Media Converter; G

Video and ESS Transmission; G

Batteries; G

Component Enclosure; G

SD-05 Design Data

Backup Battery Capacity Calculations; G

Access Control Throughput Rates

CCTV Storage Calculations

SD-07 Certificates

Contractor Qualifications; G

Instructor Qualifications; G

SD-10 Operation and Maintenance Data

Training Plan

Training Content

ESS Components and ESS Software: Data Package 4; G

ESS Software and ESS Components: Data Package 4; G

Submit data package in accordance with Section 01 78 23
OPERATION AND MAINTENANCE DATA

SD-11 Closeout Submittals

As-Built Drawings

1.3 QUALITY ASSURANCE

1.3.1 Regulatory Requirements

The advisory provisions in each of the publications referred to in this specification are mandatory. Interpret these publications as though the word "must" has been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.3.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening, and have been utilized in applications of equipment and materials under similar circumstances and of similar size.
- b. Have been available on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer.
- d. Provide commercial off-the-shelf (COTS) products in which the manufacturer allows a network of qualified distributors to sell, install, integrate, maintain, and repair the hardware and software products that make up the system.

1.3.2.1 Alternative Qualifications

Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.3.2.2 Material and Equipment Manufacturing Date

Products manufactured more than one year prior to date of delivery to the site are not acceptable.

1.3.2.3 Product Safety

System components are to conform to applicable rules and requirements of NFPA 70. Equip system components with instruction stickers including warnings and cautions describing physical safety, and special or important procedures to be followed in operating and servicing system equipment.

1.3.3 Shop Drawings

1.3.3.1 ESS Components

Submit the ESS Components, Data Package 4 with the ESS Software submittal package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit drawings that clearly and completely indicate each ESS component function that includes:

- a. Termination device points
- b. Interconnections required for system operation
- c. Interconnections between modules and devices
- d. Proposed wireway or conduit systems to be used including:
 - (1) Locations
 - (2) Sizes
 - (3) Types
- e. Drawings showing:
 - (1) Device locations and spacing
 - (2) Mounting and positioning details
 - (3) Riser Diagrams with cable sizes and types
 - (4) Bill of Materials (Device make, model and quantities)
 - (5) Alarm and access control zones
 - (6) CCTV and sensor coverage areas
 - (7) Spare capacity

1.3.3.2 Overall System Schematic

Indicate the relationship of integrated components on one-line diagram and show:

- a. Power source
- b. System controls
- c. Impedance matches
- d. Interconnecting wire data including:
 - (1) Number
 - (2) Size
 - (3) Identification
 - (4) Maximum lengths

1.3.4 Evidence of Experience and Qualifications

1.3.4.1 Contractor Qualifications

Submit experience and certified qualifications data prior to installation. Show that specific installers who will perform the work have a minimum of 2 years of experience successfully installing ESS of the same type and similar design as specified. Include the names, locations, and points of contact of at least two installations of similar type and design as specified in this document where the installer has installed such systems. Indicate the type of each system installed. Certify that each system has performed satisfactorily in the manner intended for a period of at least 12 months.

1.3.4.2 Instructor Qualifications

Submit the instructor's experience and certified qualifications data prior to installation. Show that the instructor has received a minimum of 24 hours of ESS training from a technical organization such as the National Burglar and Fire Alarm Association, and 2 years experience in installing the specified ESS type.

1.4 Environmental Conditions

1.4.1 Interior Conditions

Equipment installed in environmentally protected interior areas must meet performance requirements specified for the following ambient conditions:

1.4.1.1 Temperature

32 to 120 degrees F. Components installed in unheated security protected areas must meet performance requirements for temperatures as low as 0 degrees F

1.4.1.2 Pressure

Sea level to 15,000 feet above sea level

1.4.1.3 Relative Humidity

5 to 95 percent

1.4.1.4 Fungus

Components must be constructed of non fungus nutrient materials or be treated to inhibit fungus growth

1.4.1.5 Acoustical Noise

Components must be suitable for use in high noise areas above 100 dB, without adversely affecting their performance

1.4.2 Exterior Conditions

Components in enclosures must meet performance requirements when exposed to the following ambient conditions:

1.4.2.1 Temperature

Minus 25 to 140 degrees F

1.4.2.2 Pressure

Sea level to 15,000 feet above sea level

1.4.2.3 Solar Radiation

Six hours of solar radiation per day at dry bulb temperature of 120 degrees F including 4 hours of solar radiation at 104 watts per square foot

1.4.2.4 Rain

2 inches per hour and 5 inches per hour cyclic with wind plus one period of 12 inches per hour

1.4.2.5 Humidity

5 to 95 percent

1.4.2.6 Fungus

Warm, humid atmosphere conducive to the growth of heterotrophic plants

1.4.2.7 Salt Fog

Salt atmosphere with 5 percent salinity

1.4.2.8 Snow

Snow loading of 48 (psf) per hour; blowing snow of 4.6 psf per hour

1.4.2.9 Ice Accretion

Up to 1/2 inches of radial ice

1.4.2.10 Wind

Continual velocity up to 50 mph with gusts to 66 mph, except that fence sensors must detect intrusions up to 35 mph

1.4.2.11 Acoustical Noise

Components must be suitable for use in high noise areas above 110 dB without adversely affecting their performance. Examples areas include flight lines, run-up pads, and generator sites.

1.5 SYSTEM CALCULATIONS AND ANALYSIS

1.5.1 Backup Battery Capacity Calculations

Submit calculations showing that backup battery capacity exceeds sensor operation, communications supervision, and alarm annunciation power requirements for proposed equipment plus 25 percent spare capacity.

1.5.2 CCTV Storage Calculations

Submit calculations showing the required storage capacity for each video storage device.

1.6 ESS SOFTWARE, DATA PACKAGE 4

Submit the ESS software, Data Package 4 with the ESS Components submittal package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Describe the functions of all software in the software manual and include:

- a. All information necessary to enable proper loading, testing, and operation
- b. Terms and functions definitions
- c. Use of system and application software
- d. Procedures for system initialization, start-up and shutdown
- e. Alarm reports
- f. Reports generation
- g. Database format and data entry requirements
- h. Directory of all files
- i. All communication protocol descriptions, including data formats, command characters, and a sample of each type of data transfer
- j. Interface definition
- k. List of software keys

1.7 AS-BUILT DRAWINGS

Maintain a separate set of drawings, elementary diagrams, and wiring diagrams of the system to be used for as-built drawings. Keep this set

accurately and neatly up-to-date with all changes and additions. This set is not to be used for installation purposes.

Finish the final drawings submitted with the endurance test report in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS for as-built requirements.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a complete and integrated electronic security system (ESS) that the meet requirements of SECNAVINST 5510.36B. ESS must be compatible with Naval Station Newport's existing systems to include access control, closed circuit television and intrusion detection. ESS consisting of the following subsystems and features:

- a. Access Control System (ACS)
- b. Closed-circuit Television System (CCTV)
- c. Security Command Center (SCC)
- d. Communications System

Include materials not normally furnished by the manufacturer with the ESS equipment as specified in:

- a. Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION
- b. Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

2.2 PERFORMANCE REQUIREMENTS

Integrate the installed and operating subsystems into the overall ESS system to detect intrusion, control access, provide CCTV surveillance, provide visual verification, and perform as an entity, as specified below. Provide electronic equipment that complies with 47 CFR 15 and are suitable for the environment where they will be installed.

2.2.1 Growth Capability

Provide capability for modular ESS expansion of inputs, outputs, card readers, and remote control stations with minimal equipment modification. Software must be able to handle design requirements plus 25 percent spare capacity. Growth capability is not to be limited by the provided products.

2.2.2 Network Certification

Certify all Platform Information Technology (PIT) in accordance with 25 05 11.03 CYBERSECURITY FOR ELECTRONIC SECURITY SYSTEM.

2.2.3 Maintainability

Provide components that can be maintained using commercially available tools and equipment. Arrange and assemble components to be readily accessible to maintenance personnel without compromising system defeat resistance and with no degradation in tamper protection, structural integrity, EMI or RFI attenuation, or line supervision after maintenance

when it is performed in accordance with manufacturer's instructions.

2.2.4 Availability

Provide components rated for continuous operation. Provide solid-state electronic components mounted on printed circuit boards, conforming to UL 796. Provide boards that are plug-in, quick-disconnect type. Do not impede maintenance with densely packed circuitry. Provide power-dissipating components with safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current-carrying capacity. Provide solid-state type or hermetically sealed electromechanical type light duty relays and similar switching devices.

2.2.5 Fail-Safe Capability

Provide fail-safe capability in critical elements of the ESS including, but not be limited to, the capability to monitor communication link integrity and to provide self-test. Provide fault annunciation when diminished functional capabilities are detected. Annunciate fail-safe alarms to clearly distinguish from other types of alarms.

2.2.6 Line Supervision

Provide the same geographic resolution for fault isolation at the systems level as provided for intrusion detection. Provide either a static or dynamic system with active mode for line supervision of communication links of the ESS.

- a. The static system must represent "no-alarm" always by the same signal, which is different than the originally transmitted signal.
- b. The dynamic system must represent "no-alarm" with a signal which continually changes with time.

2.2.7 Power Loss Detection

Detect AC and DC power loss and generate an alarm when a critical component of the system experiences temporary or permanent loss of power. Annunciate the alarm in the Secured Area and the Security Command Center to clearly identify the component experiencing power loss.

2.2.8 Controls and Designations

Provide controls and designations as specified in NEMA ICS 1.

2.2.9 Special Test Equipment

Provide all special test equipment, special hardware, software, tools, and programming or initialization equipment needed to start or maintain any part of the system and its components. Special test equipment is defined as any test equipment not normally used in an electronics maintenance facility.

2.2.10 Electromagnetic Interference (EMI)

Configure and provide ESS components employing electromagnetic radiation constructed to provide minimal vulnerability to electronic countermeasures.

2.2.11 Electromagnetic Radiation (EMR)

Provide only ESS communication components which are Federal Communications Commission (FCC) licensed and approved. Provide system components which are electromagnetically compatible.

2.2.12 Interchangeability

Use off-the-shelf components which are physically, electrically, and functionally interchangeable with equivalent components as complete items. Equivalent, replacement components must not require new or other component modification. Do not use custom designed or one-of-a-kind items. Interchangeable components or modules must not require trial and error matching in order to meet integrated system requirements, system accuracy, or restore complete system functionality.

2.3 DATA ENCRYPTION

All data encryption will be in accordance with NIST FIPS 201-2 and NIST FIPS 140-3.

2.4 INTRUSION DETECTION SYSTEM (IDS)

The IDS primary function is to detect intrusion into secured areas. Utilize a single database for all IDS programming data that seamlessly integrates with the ESS under a single operating environment. The IDS events must be viewable as separate or as a combined list of all ESS events. Control the IDS alarm monitoring through software control from the ESS.

- a. Provide both supervised and non-supervised alarm point monitoring.
- b. Secure or access alarm points both manually and automatically by time of day, day of week or by operator command.

2.4.1 IDS Components

Provide components:

- a. Premise Control Units (PCU)
- b. Detection Sensors
- c. Tamper Switches

2.4.2 Detection Sensitivity

The sensitivity of the IDS must allow for the following:

- a. Locating intrusions at individually protected assets or at an individual portal
- b. Locating intrusions within the coverage on a single volumetric sensor
- c. Locating failures or tampering at individual sensors

2.4.3 Detection Alarm and Reporting Capacity

Collect, communicate, and display up to 32 sensor zone alarms and to

enable control of card reader for secure and access.

Identify individual sensors in alarm if the sensor zone is a multiple alarm source combination. Annunciate a single alarm within 1 seconds maximum, after sensor transducer or other detection device activation.

2.4.4 False Alarm Rate

The false alarm rate for each interior IDS zone must not exceed one false alarm per 30-day period. The false alarm rate for each exterior IDS zone must not exceed one false alarm per 24-hour period.

2.4.5 Nuisance Alarm Rate

The nuisance alarm rate for each interior IDS zone must not exceed three nuisance alarms per 30-day period. The nuisance alarm rate for each exterior IDS zone must not exceed three nuisance alarms per 24-hour period.

2.4.6 Premise Control Unit (PCU)

Install the PCU command processor in a tamper resistant enclosure that is specified in paragraph "Component Enclosure". Package the following with the PCU:

- a. Power transformer
- b. Battery(s)
- c. Network connection cable
- d. Additional components as required for full functionality

2.4.6.1 PCU Capabilities

The Premise Control unit must be an Intelligent System Controller (ISC) and is designed for advanced access control applications. As the access control engine for the system, the PCU provides power and functionality. The PCU can communicate to the host computer in a single- or dual-path Ethernet configuration. Multiple combinations of Input Control Modules, Output Control Modules and Card Reader Interface Modules (up to 64 devices) can be configured.

Utilizing its native Ethernet communications and an advanced 32-bit processor, the PCU can communicate upstream to the host computer through its primary Ethernet port. Additionally, the PCU must have an optional secondary communications option, through a USB to Ethernet connection.

2.4.6.2 Overcurrent Protection and Indication

When overcurrent more than it is rated for is detected by the PCU, communication bus(es) and keypad(s) are to be shut down and an overcurrent notification LED lit to indicate the situation.

2.4.6.3 Manual and Self-Test

All testing from any alphanumeric keypad include testing for: standby battery, alarm bell or siren, and communication to the Security Command Center (SCC). Include provisions for an automatic, daily, weekly, 30 day, or up to 60 day communication link test from the PCU installation site to

the SCC. Include a provision for displaying the internal system power and wiring conditions.

Include the following for internal monitoring points:

- a. The bell circuit
- b. AC power
- c. Battery voltage level
- d. Charging voltage
- e. Panel box tamper
- f. Phone trouble line 1
- g. Phone trouble line 2
- h. Transmit trouble
- i. Network trouble

A battery test must be automatically performed to test the integrity of the standby battery by disconnecting the standby battery from the charging circuit and placing a load on the battery. Perform this test at an interval no greater than 180 days.

2.4.7 Detection Sensors

- a. Required power is 12 VDC or 24 unless otherwise specified.
- b. Provide line supervision for all sensors with an end-of-line resistor at the sensor or within a tampered junction box with conduit from the junction box to the sensor.
- c. Provide sensors and components rated for operation in the installed environment. The sensors must transmit an alarm signal to the alarm annunciation system upon change detection. Provide all sensors with a tamper switch and elements housed in a tamper-alarmed enclosure in accordance of paragraph "Component Enclosure".

2.4.7.1 Interior Sensors

2.4.7.1.1 High Security Balanced Magnetic Switch (BMS)

Mount the BMS inside the secure location and on the opening side of the door. BMS sensors do not have the capability to incorporate an end-of-line (EOL) resistor.

2.4.7.1.1.1 Level 2 Switch

UL 634. Level 2 High Security

2.4.7.2 Tamper Switches

- a. Corrosion-resistant tamper switches are required for the following IDS and CCTV equipment with hinged doors or removable covers that contain open circuits:

(1) Enclosures

(2) Cabinets

(3) Housings

- b. Tamper switches are to initiate an alarm signal when the door or cover is moved as little as 1/4 inch from the normally closed position. Mechanically mount tamper switches to maximize defeat time when enclosure covers are opened or removed. One second is the minimum amount of time required to depress or defeat the tamper switch after opening or removing the cover. Enclosure and tamper switch must prevent direct line of sight to internal components and prevent switch or circuit tampering. Conceal mounting hardware so switch cannot be observed from enclosure exterior.
- c. Tamper switches on doors which are opened to make normal maintenance adjustments to the system and to service power supplies must have a maintenance position. Provide two positions tamper switches.

2.4.7.2.1 Tamper Switch Performance Requirements

Tamper switches are to be:

- a. Inaccessible until switch is activated.
- b. Under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating.
- c. Annunciated to be clearly distinguishable from intrusion detection alarms and exempt from being disarmed, shunted, or silenced.
- d. Spring-loaded and held in the closed position by the door, or cover protected.
- e. Wired to break the circuit when the door or cover is disturbed.
- f. Wired so that each sensor and device is annunciated individually at the central reporting processor.

2.5 ACCESS CONTROL SYSTEM (ACS)

Provide an access control system based upon a modular distributed microprocessor architecture complete with access control cards and ready for operation.

- a. The ACS card credentials are required to be Common Access Cards (CAC), and CAC cards are being provided by the Government. Interface system with and provide alarm and other status to the overall ESS. Provide ACS that meets the communications requirements of UL 1076 and UL 294 and has the capability of controlling up to 2 card readers and keypads per card reader controller, 128 alarm inputs, or 128 relay outputs or any components combination.
- b. System is to grant or deny access or exit based upon:
 - (1) CAC card identification data

- (2) Input through the access control devices compared to data stored within the system
- (3) Time of day, day of week, and special day and holiday scheduling with card validation override.
- c. Decision to grant or deny access or exit is to be based upon authorization for such data to be input at a specific location for the current time period.
- d. Provide ACS that supports the configuration and simultaneous monitoring of multiple access control devices when TCP/IP communication interfaces are used between the ESS and the primary Access Control Unit (ACU). The events of the ACS are to be viewable as separate or as a combined list of all ESS events. Provide overall control of the ACS, alarm monitoring, and photo identification through software control of the ESS.
- e. Access control, photo imaging, and programming data must reside on a single database and instantly accessible to every networked PC workstation connected to the ESS.
- f. Provide both supervised and non-supervised alarm point monitoring.
- g. Provide the capability to arm or disarm alarm points both manually and automatically by time of day, day of week or by operator command and the capability to disarm alarm points based on a valid access event.
- h. Provide programmable 'delay' setting for all alarm points. The alarm points are not to report an ENTRY type alarm until the delay setting has expired and not report a dwell type alarm condition until the alarm has been active for the full delay period.
- i. Provide the capability to place ACU(s) in an off-line mode. In the off-line mode, the ACU(s) must retain a historical summary of all ACU activity transactions, up to the maximum capacity of the ACU memory buffer. Provide the ability for manual operator control of system output relays with the manual functions to energize, de-energize, enable or disable.

2.5.1 ACS Programming

Provide software capable of, but not limited to, the following programming:

2.5.1.1 Time Schedules

Provide up to 256 user-definable time schedules. These time schedules are to determine the day(s) and times that access will be granted or a scheduled event is to occur. Any and all of the time schedules are to be available for defining access privileges and scheduled events. Provide ALWAYS and NEVER schedules that cannot be altered or removed from the system. Each user-defined time schedule must have the option of reacting or not reacting to user-defined special days, with the ability to react uniquely to each type of special day.

2.5.1.2 Special Days

Provide an unlimited number of user definable special days to be used for configuring exceptions to the normal operating rules, typically for

specifying holiday operating rules. Allow for each special day to be assigned to a user-defined type.

2.5.1.3 ACU Daylight Savings Time Adjustment

Provide a software-configurable, user defined adjustment for Daylight Savings Time. The ACU must not need to be connected to a PC workstation in order for the adjustment to occur.

2.5.1.4 Scheduled Events

Any access controlled reader is to be capable of scheduled unlock periods to allow for card-free access. The access controlled reader is to also be capable of requiring one valid access event before beginning a scheduled unlock period.

Any access control point is to be capable of requiring a valid card as well as a PIN code via keypad on a scheduled basis for high security areas. The use of PIN via keypad functions must not reduce the number of card readers or alarm points available in the ACU(s). Any designated alarm input must be able to be scheduled Secured and Accessed. Any relay output must be capable of scheduled ON and OFF periods to allow for automatic input and output system control.

2.5.1.5 Maximum User Capability

Up to 64,000 individual users may be given access cards or codes and have their access controlled and recorded.

2.5.1.6 Access Groups

Each system user must be assignable to a maximum of 4 of 256 possible access groups. An access group is defined as one or more people who are allowed access to the same areas at the same days and time periods.

2.5.1.7 Active and Expire Dates

Any card or user may be configured with activation and expiration dates. The card can be assigned to any valid access group and will be activated and expired according to the specified dates.

2.5.1.8 Maximum Use Settings

Any card or user may be configured with maximum number of uses for that card. The card can be assigned to any valid access group and will be expired according to the specified number of card uses.

2.5.1.9 Door Outputs

Provide each access control reader with two dedicated relay outputs. Both relays are to provide Normally Open and Normally Closed contacts. Use the first relay for electric lock control while the second is software configurable to activate for door forced open, door left open too long, duress, passback violations, invalid access attempts and valid unlock conditions. Allow for both relays to be separately programmable for energize times from 1 second to 10 minutes. The second relay must allow a delay time to be specified, causing its activation to be delayed after an activating condition occurs.

2.5.1.10 Anti-Passback

Provide global anti-passback capability. Any door on the system can be linked to one of 256 user defined passback areas or pre-defined areas. Each door may be set up to automatically forgive passback entries at one of the following intervals:

- (1) Never
- (2) Midnight
- (3) Every 12 hours (Midnight and Noon)
- (4) Every 6 hours
- (5) Every 2 hours
- (6) Each hour
- (7) Every 30 minutes

Each door can be configured to deny or grant access for passback violations and individual users can be exempt to the passback rules. The anti-passback features must be a global function and operate completely independent of the ACS software, except configuring the passback rules. Additionally, the operator is to have the ability to manually forgive an individual user or all users by command from the ACS.

2.5.1.11 User List or Who's In (Muster Reports)

Provide the capability to generate dynamic lists of users in certain access-controlled areas, based either upon selected users or selected areas. The lists must have the option of automatically refreshing after a user-selected interval of time.

2.5.1.12 Crisis Mode

Provide support for a "crisis mode", in which user-selected alarm point activations cause changes to user access privileges. The changes to user access privileges must be configurable to restrict normal access to no access or limited access.

2.5.1.13 Door Groups

Allow up to 256 door groups to be configured. Doors belonging to the same group are able to be locked, unlocked, disabled, and enabled on command from the ACS.

2.5.1.14 Door Interlocking

Allow a group of doors to be software configured so that if any door in the group is unsecure, all other doors are automatically disabled. This feature is also known as a "mantrap" configuration. The interlocking features must not require the ACS to be on-line for proper operation.

2.5.1.15 Remote Door Control

Provide the ESS operator the capability of manually controlling any access point by issuing a simple command from the ACS. Provide the operator the

ability to lock, unlock, enable, and disable any door or Door Group in this manner. This activity is to cause an entry to be logged displaying the door name, number and time that it was performed.

2.5.1.16 Key Control

When interfaced with an approved key-control system, the system is to allow users to deny access to certain doors for any users who have keys in their possession.

2.5.1.17 Reader Disable

Provide support for disabling readers in reaction to a user-selected number of invalid access attempts. Locate a camera to view the card reader and interface to record the events of invalid access attempts.

2.5.1.18 Disable Event Messages

Allow users to disable user-selected event messages (Door Forced Open, Door Open Too Long, Door Closed, Request to Exit) for user-selected doors. Allow users to disable certain messages (Door Forced Open, Door Open Too Long) according to a user-selected schedule.

2.5.1.19 Input and Output Groups

Allow for up to 256 user-defined (input and output) groups to be defined. Each Input device is to be able to be linked to these groups for arming, disarming, shunting and unshunting as well as output control.

2.5.1.20 Delays

Each alarm device must allow a delay to be specified which is either an entry type or a dwell type. An entry-type delay is to prevent the input from issuing an alarm event until the delay elapses. If unarmed during the delay period, the alarm is to be ignored. A dwell-type delay requires the input to remain in the alarm state for the full delay duration before issuing an alarm.

2.5.1.21 Output Configuration

Allow each output relay to be software configurable as:

- (1) Follows
- (2) Latch
- (3) Timeout
- (4) Scheduled
- (5) Timeout Re-triggerable
- (6) Limit
- (7) Counter

Allow for a time schedule to automatically control the activation and de-activation of the Scheduled type with all other types configured to activate based on input and output group conditions. Additionally, a time

schedule must be specified to configure when the output is to actively monitor the input and output groups.

2.5.1.22 Remote Reset Command

Provide the capability for any ACU to reset manually or by command issued from the ACS with the option of simulating the ACU reset settings, or forcing a reset type as specified by the user. The remote reset command is not to cause the ACU to degrade its level of protection to any access points defined.

2.5.1.23 Time Zone

Allow the user to select the time zone in which the ACU is located, so that event times displayed for that ACU will match the local time where the ACU is located.

2.5.1.24 User-Selected LED Behavior

Allow the user to select different behaviors for the LEDs of each access controlled reader.

2.5.1.25 Traced Cards

Provide the capability of selecting any number of cardholders for the purpose of limiting reports to only traced users displaying all traced cardholder events in a user-selected alternate color.

2.5.2 Error and Throughput Rates

Rates must be portal to portal performance averages obtained when processing individuals one at a time. Features are not to reduce capability to meet throughput requirements when serial verification techniques or multiple attempts are required to satisfy error performance requirements.

A Type I error denies access to an authorized enrolled individual. A Type II error grants access to an unauthorized individual. Subsystem Type I and Type II error rates must both be less than 0.1 percent. At the error rates, subsystem access throughput rate must be minimum of 12 individuals per minute through one card reader and keypad access control device.

2.5.3 Access Control System Central Processing

- a. Central processing is to be accomplished at the Primary Control Unit (PCU). Provide serial management and control of system processing. Provide a microprocessor control device able to monitor and control units and up to 32 card reader and keypad access control devices. Central processor must interrogate and receive responses from each ACU within 100 milliseconds. Failure to respond to an interrogation is to cause an alarm.
- b. Provide the central processor with a Ethernet interface port to communicate with the printer. Provide an operator interface to control system operating functions. Provide the central processor with a facility-tailorable data base for a minimum of 1000 cardholders with by-name alphanumeric printout, and for automated IDS monitoring, management, and control functions.

- c. Provide system configuration controls and electronic diagnostic aids for subsystem setup and troubleshooting with the central processor. Components are not to be accessible to operations personnel and must be tamper alarmed.

2.5.4 Access Control Unit(ACU)

UL 294. Provide micro-processor based ACU with all access and input and output decisions to be made by the individual ACU(s). Provide modular solution which will allow for present security requirements and the capability to expand. Configure all field ACU panels to intercommunicate via RS-422/485. Equip all field ACU(s) with a tamper contact.

Designate the PCU as "Primary", responsible for all ACS-to-ACU communications. All other ACU(s) up to a maximum of 32 are to be designated as "Secondary" and communicate with the "Primary" via an RS-422/485 hardwire. Provide ACU capable of, but not limited to, the following:

- a. Built-in surge suppression circuitry on plug-in modular circuit boards with surge suppression, configured as an integral component of the system and self-sacrificing in the event of extreme surges or spikes.
- b. Capable of supporting at least 10 ports.
- c. Each port configured by ACS to support any one of the following peripheral devices:
 - (1) Card reader
 - (2) Alarm Monitoring Module
 - (3) Output Relay Module
 - (4) Electric Strike
 - (5) Balanced Magnetic Switch
 - (6) Request to Exit Pushbutton

Any device combination can be supported on each ACU, up to a total of 8 devices per ACU.

- d. Capability of supporting multiple card reader technologies simultaneously, including:
 - (1) Keypad
 - (2) Card and Keypad
 - (3) CAC compatible

This capability must be an integral part of the ACU and will not require special external equipment.

- e. Built-in battery back-up of programmed information sustainable for a period of at least 90 days. Back up power is to be provided by locally installed batteries at the ACU enclosure for continuous operation for 8 hours.

- f. Powered by a 12 or 24 VDC power source rated at a minimum of 4A amperes with a battery back-up for complete system operation in the event of power failure. Provide battery backup for all ACU(s) to sufficiently power the ACU for 8 hours continuous service.
- g. Electric latch retraction devices must be on a separate power supply with battery back-up for continued operation in the event of power failure as specified in paragraph "Backup Power". Electric Strikes are to be powered from the ACU power supply.
- h. A minimum of a 10,300 event log buffer per ACU to record and hold access and alarm activity information until the ACS is connected and receives the information. Provide a software-configurable warning log buffer filling notification for ACU(s) configured with network switch capabilities.

2.5.5 Access Control Devices

UL 294. The card, card reader, and panels must meet encryption requirements that are specified in paragraph DATA ENCRYPTION. Devices are to be tamper alarmed, tamper and vandal resistant, and solid state, containing no electronics which could compromise the access control subsystem should the subsystem be attacked.

2.5.5.1 Card Readers

Providesurface, pedestal, or weatherproof mountable card readers as indicated for each individual location. Provide contactless type card readers capable of reading CAC cards.

2.5.5.1.1 Contactless Card Readers

Provide contactless card readers that can read credential CAC cards whose characteristics of size and technology meet those defined by ANSI ISO/IEC 7816 in close proximity to the card reader and are in compliance with NIST FIPS 201-2.

Provide readers with "flash" download capability to accommodate card format changes and the capability of reading the card data and transmitting the data, or a portion thereof, to the ESS control panel.

2.5.5.1.2 Card Reader Display

Provide card readers with an LED or other visual indicator display which indicate power ON and OFF and whether user passage requests have been accepted or rejected.

2.5.5.1.3 Card Reader Response Time

The card reader is to respond to passage requests by generating a signal to the local processor.

2.5.5.1.4 Card Reader Power

Power the card reader from the ACU. The card reader must not dissipate more than 5 Watts.

2.5.5.1.5 Card Reader Mounting Method

Provide card readers suitable for surface, pedestal, or weatherproof mounting as required.

2.5.5.2 Portal Control Devices

Portal control devices must meet the requirements in Section 08 71 00 DOOR HARDWARE.

2.5.6 Access Control Media Converter

Able to convert 2-wire RS485 to single-mode fiber. Fiber output operates at 1300nm wavelength using an LED emitter and photo-detector on SC type connectors. Maximum distance of fiber transmission is 16 miles with a speed of 500kbps. Serial connection is to utilize screw type terminals. Operating temperature of -68 F to 140 F. Converter is to meet standards/refulations EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, and EN61000-4-6. Unit is to have a UL 508 listing. Data transmission maximum input distortion of +- 3.5% and a max output distortion of <6.25%. Nominal supply voltage of 24 VDC with a supply range of 18VDC to 32VDC. Serial interface is to be semi-duplex with automatic data direction switching. Unit must be able to be mounted to a 35mm DIN rail.

2.5.6.1 Access Control Media Converter Power Supply

Power supply must be capable of mounting to a 35mm DIN rail system. Input voltage of 120VAC with an output voltage of 24VDC. Maximum power output of 60W.

2.6 CLOSED-CIRCUIT TELEVISION (CCTV) SYSTEM

Select system components that conform to the Open Network Video Interface Forum (ONVIF) specification. Provide compatible UL listed CCTV components to provide visual assessment of alarms automatically upon alarm. Otherwise, the subsystem is to continuously display the coverage area. Display alphanumeric camera location ID on all monitors. Provide the number of alarm monitors as required. The scene from each camera must appear clear, crisp, and stable on the respective monitor during both daytime and nighttime operation. Provide component equipment that minimizes both preventive and corrective maintenance. Provide components from a single manufacturer or justify mixing manufacturer components and demonstrate compatibility in submittal information.

2.6.1 Cameras

2.6.1.1 CCTV Camera

Provide cameras of digital fixed, pan-tilt-zoom (PTZ), or panoramic type as identified on the drawings.

- a. Provide power for camera as indicated on drawings. Power over Ethernet (PoE) must meet IEEE 802.3. DC and AC power supplies providing 24V must be UL certified.
- b. All cameras must be constructed to provide rigid support for electrical and optical systems so that unintentional changes in alignment or microphonic effects do not occur during operation, movement, or lens adjustments.

- c. Video Frame Rate: 30 frames per second (fps)
- d. Minimum essential requirements for cameras include the following:
- e. Fixed Camera Casing: Casing must be IP66/IP67-, NEMA 4X-, and IK10-rated casing made of a Polycarbonate blend and aluminium, white in color.
- f. PTZ Camera Casing: Casing must be IP66-, and NEMA 4X-rated powder coated aluminum, white with a tempered glass front window. Front window must have a anti-reflective coating and long-life silicone wiper. Sunshield must be high-impact UV-stabilized thermoplastic
- g. Video Compression: H264

2.6.1.1.1 Pan/Tilt/Zoom Camera

Provides HDTV video quality, 30x zoom, Wide Dynamic Range (WDR), focus recall. It features both RJ45 and SFP interfaces, enabling a long-distance fiber connection with a failover network link. Capable of operating in extreme temperatures, withstanding hurricane-strength winds and including an integrated long-lifewiper removing raindrops, dirt and grime.

Pan: 360° endless, 0.05°/s to 120°/s

Tilt (default): -90° to +45°

Tilt (inverted a): -45° to +90°

Tilt speed: 0.05°/s to 60°/s

Jerk-free movements at low speed: ±0.01°/s (at 0.05°/s)

Zoom: 30x optical zoom, 12x digital zoom, total 360x zoom

Preset accuracy: 0.05°

256 preset positions, guard tour, control queue, on-screen directional indicator, focus window, speed zoom, focus recall, de-icing control, dynamic load balancing.

Camera must have a SFP port to allow for a 1000Base-LX SFP Fast Ethernet Interface Converter (transceiver). Transceiver is to be a hot swappable device that plugs into the SFP port and communicate via OM3 multi-mode fiber cable.

2.6.1.1.2 Fixed Bullet Cameras

Provides excellent image quality in HD. Capable of delivering true colors and great detail in challenging light or near darkness. Software analytics lets you detect and classify humans and vehicles. Camera will have motion-adaptive exposure significantly reducing the motion blur from approaching or nearby objects. IR enables surveillance in pitch darkness. The outdoor-ready camera comes with either a wide or a telelens.

Varifocal, 3-9 mm, F1.6-3.3

Horizontal field of view 114°-37°

Vertical field of view 58°-21°

Varifocal, Remote focus and zoom, P-Iris control, IR corrected

PoE camera meeting IEEE 802.3af/at Type 1 Class 3. Camera to operate between -40F to 140F. Camera to have a digital PTZ and zoom feature. Camera to connect via RJ45

10BASE-T/100BASE-TX/1000BASE-T.

2.6.1.1.3 Resolution

Provide as indicated on drawings. Resolution is to be maintained over the specified input voltage and frequency range, and not vary from minimum specification over the specified operating temperature range.

2.6.1.1.4 Synchronization

Provide cameras that have internal and line lock.

2.6.1.1.5 Low Light Level

Provide Day-Night cameras that have a B-W mode that may be automatically engaged on low light level and permit the use of an external infrared illuminator. Electronic removal of the color signal is not acceptable. The camera must have an infrared cut filter capable of being removed automatically upon low light threshold or manually.

2.6.1.2 Camera Housing and Mounts

2.6.1.2.1 Interior Mount

Provide camera mount suitable for either wall or ceiling mounting and have an adjustable head for mounting the camera.

2.6.2 Ancillary Equipment

Equipment is to consist of the items specified below:

2.6.2.1 Video Date and Time Generator

The video time and date is to originate from either the camera, video, video recorder, or time server.

2.6.2.2 Camera Identifiers

Label video signal from each camera using alphanumeric identifiers. Camera alphanumeric identifiers may originate from either the camera or the video recorder.

2.6.2.3 Video Recording

2.6.2.3.1 Network Video Recorder (NVR)

- a. Provide NVR with an integral software ESS-CCTV server function. Dedicated CCTV monitors and authorized computers networked to the NVR are to be capable of viewing recorded and live video from the network. The NVR is to be able to record and transmit video with up to 30 fps at maximum camera resolution. The NVR is to network with and utilize smaller, non-server computers at off-site camera locations as local recorders.
- b. Provide NVR with the capability to de-warp live and recorded images.
- c. The NVR must have the capacity to address and process up to 16 dual-streaming cameras. The NVR must record all cameras onto a hard drive and allow remote network viewing via intranet browser. Hard drive capability must be sized to store all cameras recording 24 hours a day 7 days a week at 30 frames per second per camera for 4 weeks.

2.6.2.3.2 Video Recording Performance

The video recording performance is to be as follows:

- a. The NVR is to use solid-state drive media, with a digital format capacity of 50 per module.
- b. Provide video multiplexing to one single monitor via video management software.
- c. Provide a 10-100Base-T connection for record review and camera view and control that is compatible for a PC workstation equipped with latest Internet Browser Software.
- d. PC workstation Viewing: Include direct access from an ESS PC workstations to each NVR via a Microsoft Internet Explorer Web Browser. All necessary descriptive bookmarks and shortcuts are to be prepared on each PC workstation to allow this direct access. All functions are to be accessible through HTML commands from a user's web browser interface. Pictures are to be available for attachment via a user-provided SMTP-based e-mail transport system, and included capability for 16 users and 3 user access levels (admin, control and user).
- e. Include sampling at 1920 x 780P (Pixel Memory) with 30 frames per second and 3-D scan conversion to enable jitter-free stabilized pictures in a single frame. Modes include:
 - (1) Emergency
 - (2) Event
 - (3) Schedule
 - (4) Manual Recording
- f. Each camera is to support individual Recording Rate and Image Quality settings for each mode (Emergency, Event, Schedule and Manual Recording). This array of Camera Recording Rate and Image Quality settings by the Recording Modes is to form one of four Program Actions. The Program Action is to be assignable to a Time Table to form one of 16 Independent Recording Profiles. Allow each Recording Profile to be manually activated, activated via RS-232C interface, automatically activated by Time Table, or activated by separate alarm or emergency inputs.
- g. Digital display on the monitor and also recording of the following information to included:
 - (1) Year
 - (2) Month
 - (3) Day
 - (4) Hour
 - (5) Minute

(6) Second

(7) Alphanumeric camera location ID up to 8 characters. The NVR is to feature video loss detection on all channels.

- h. Pre-event recording: Buffer at least 20 seconds of pre-event pictures simultaneously for all individual camera channels.
- i. Disk Partitioning: Provide within the NVR an automated disk management and a RTOS (real-time operating system) platform to include a minimum of 4.8 TB of digital video storage on a single partition.

The video recording system is to provide a choice of Physical Partitioning as RAID 0 or Disk Mirroring redundant array recording. Allow the operator to be able to partition the available recording areas in a Virtual Partition by Regular, Event, and Copy Partitions. Manually and Scheduled recorded video information is to be assigned to a Regular Recording Partition, which may be overwritten. Event and Emergency Recording Data is to be assignable to an Event Partition, where image overwriting is prohibited. Any copied data is to be able to be assigned to the Copy Partition, which may be overwritten or saved as required.

- j. Playback: Permit direct camera selection for recording playback of any of 16 video sources at the same time as multiscreen viewing and multiplexed camera encoding (triplex multiplexer capability).
- k. Multiplexer Functions: The unit must have full screen, 4 multiscreen monitoring modes.

l. Outputs

(1) Provide RS-485 serial interface.

(2) Provide 4 independent Video Outputs assignable to Multiscreen .

- m. Networking: All NVR recording, review, playback, camera control and setup are to be available via the internally mounted Network Interface. A 10-100Base-T connection for record review and camera view and control will be required on a personal computer equipped with Internet Browser Software and an Ethernet 100Base-T connection. Permit direct camera selection for recording playback of any of 16 video sources at the same time as multiscreen viewing and multiplexed camera encoding (triplex multiplexer mode). Support a minimum of 8 simultaneous clients viewing and 2 simultaneous FTP sessions.
- n. Power: The video recording equipment must have a power source of 120 VAC at 60 Hz.

2.6.2.4 Camera Control

Provide access to camera functions and control for all cameras via the video management software.

2.6.3 Camera Mounting Structures, Pole

Provide camera mounting structures designed specifically for CCTV cameras. The structure is to accommodate appropriate wiring pathways for

power and communication as well as proper grounding and surge protection. Design loads for the camera mounting structure must conform to TIA-222 and all applicable addendums of the TIA standard. Allowable pole deflection is determined from the point of the camera mount and must not exceed 0.5 percent of the pole height under adjusted maximum wind load conditions. Adjusted maximum wind load conditions for deflection calculations must be 130 miles per hour (mph) or 35 percent of the basic wind speed as determined by TIA-222, whichever is greater. Confirm compliance to TIA standards by structure manufacturer data or by analysis. Provide additional measures as required to stabilize the camera if placed in an environment that is subject to induced vibrations such as heavy winds or excessive traffic. Pole must have a top mounting plate to allow for 360 degree views from camera with no obstruction from the pole.

2.6.4 Media Converter Modular Chassis

Chassis must be made of steel and coated to resist corrosion. It must be capable of carrying 19 media converter cards along with AC power supplies for the media converters. The media converter chassis must allow for hot swapping of power supplies. Chassis must not be larger than two rack units (2RU). The AC power supply must be 120V and provided with a standard NEMA 5-15 plug with ground. There must be an alarm relay system to provide alarm statuses on power supplies within the chassis. Alarms must be loss of power, fan failure, over temperature, and over voltage.

2.6.5 Media Converters

2.6.5.1 Camera Media Converter

Media converter must be capable of converting video signals from fiber to ethernet category 6 media. Converter must utilize conversion from single-mode to ethernet via ST connectors. Converter must provide power-over-ethernet capability in a wattage enough to power the camera. Converter source voltage must be 120V and use a standard NEMA 5-15 plug.

2.6.5.2 Chassis Media Converter

Media converter must be capable of converting video signals from copper category 6 to single-mode (OS2) fiber media. Converter must utilize ST connectors.

2.7 SECURITY COMMAND CENTER (SCC)

The SCC must be a location for viewing the CCTV cameras. This position can selected by accessing the cameras via the CCTV network. Location to provide an operator control interface to the CCTV system.

2.7.1 Printers

2.8 ESS SOFTWARE

- a. Provide commercial off-the-shelf ESS software that utilizes a single database for the subsystem integrations provided under a single operating environment. The system is to archive all events in a database stored either on a local hard drive or a networked database server. The software has to support configuration and simultaneous monitoring of all subsystems.

- b. Allow the networked PC workstation configurations connected via a TCP/IP network. Administrative tasks including configuration, monitoring, schedules, report generation and graphic display are provided from any PC workstation on the network. All system programming data must be instantly accessible to every PC Workstation connected to the network. The system is to utilize a non-proprietary SQL-based, ODBC-compliant database, managed by Sybase Adaptive Server Anywhere, Microsoft SQL Server, or Oracle.
- c. Utilize a preemptive multi-tasking operating system, such as the latest Microsoft Windows Professional environment, that is multitasking, with many processes running at the same time without interference with each other and with higher priority tasks taking precedence over lower priority tasks.
- d. Provide capabilities to define visual exclusion areas.

2.8.1 Alarm Call up

Support responses to alarms entering the system with each alarm capable of initiating one or more of the following actions:

- a. Sending alarm commands to a CCTV system interface
- b. Display graphical maps associated with the alarm device

Provide mode of system operation that requires an operator to acknowledge any alarm. While alarm is still active, the alarm cannot be cleared.

2.8.2 Programming

Provide the capability of, but not limited to, the following programming and functionality:

2.8.2.1 Daylight Savings Time Adjustment

The ACU(s) and PCU(s) must not need to be connected to the ESS in order for the adjustment to occur.

2.8.2.2 Operator Privileges

Support an unlimited number of system operators, each with a unique login and password combination. Operators are to be assigned privileges based on the loops, commands, or programming features that are available to each individual operator.

2.8.2.3 Alarm Priorities

Provide the ability for each alarm device to be user configured to belong to one of 10,000 priority levels which are assigned to an alarm based on alarm importance. These priorities are to define which alarm events to display on individually specified ESS workstations.

2.8.2.4 Reports

Include integrated reporting capabilities as well as the ability to run Crystal Report templates.

2.8.2.5 User Interface

The ESS programming is to be menu-driven, with "wizards" to assist with software configuration, and include 'Help' information.

2.8.2.6 Messages

Permit the use of user-selected colors for event messages.

2.8.2.7 Graphics

Provide the capability to display a floor-plan graphic for card activity and alarm events as part of the ESS integration.

2.8.2.8 Device Status

Provide the capability to display the dynamic status of a user-selected list of devices, including doors, inputs, and outputs.

2.8.2.9 Diagnostics

Include diagnostic software tools that interface and query the hardware for information and to issue commands.

2.8.2.10 Mandatory Data Fields

Require any cardholder data field to be selected by the user as mandatory.

2.8.2.11 User Defined Data Fields

Provide 20 unassigned data fields for storing user-defined data that support user-defined labels, and are user-configurable as plain text fields or drop-down selection lists.

2.8.2.12 Archive Database

Include a connection to an archive database which stores purged events and deleted programming and which can be accessed for reporting.

2.8.2.13 Programmable Database Backup

Include the capability of performing user-scheduled database backups without the use of third-party backup software.

2.8.2.14 Programmable Database Purging

Include the capability of performing user-scheduled database purging, moving selected events to an archive database when the events have aged a user-specified number of days.

2.8.2.15 Database Importing

Include the capacity to import user data from an ODBC data source (Access, Excel, text).

2.8.2.16 Data Exporting

Include the capacity to export data from any table in the database to either a Excel file in any user-selected order.

2.8.2.17 Event Log Output

Include the capacity to send a continuous stream of user-selected types of event messages to a text file, serial port, or TCP/IP address.

2.8.2.18 Data Audit Trail

Record changes to programming, recording the date and time stamp of the change, the name of the operator making the change, and the nature of the change. This data audit is to be available in history for reporting.

2.8.2.19 ESS Monitor Display Software

ESS Monitor display software is to provide for text and graphic map displays that include zone and device status integrated into the display. Different colors are to be used for the various components and real time data. Colors must be uniform on all displays. Follow the color coding as follows.

- a. FLASHING RED to alert an operator that a zone has gone into an alarm or that primary power has failed.
- b. RED to alert an operator that a zone is in alarm and that the alarm has been acknowledged.
- c. YELLOW to advise an operator that a zone is in access.
- d. GREEN to indicate that a zone is secure or that power is on.

2.8.2.20 Graphical Map Software

- a. ESS graphical map software is to show the visual data of all subsystem devices. Use a 24 inches, LED flat screen display with messages displayed in the English language. Provide graphical maps showing a layout of all the protected facilities. Highlight zones corresponding to those monitored by the ESS on the graphical maps. Display status of each zone using graphical icons as required within each designated zone.
- b. Provide capability for graphical maps to be linked together using a layered tree structure. For example, a top-level map might be a top view of the site and its buildings, the next level the individual buildings floor, followed by a map of the area on a floor containing the device in alarm. Allow for 3 layers of maps to be defined for any given ESS device. To speed an incident location, each map level contains a clearly visible indicator as to which sub map the operator should select next to find the device that is in alarm.
- c. The ESS may also be configured to display a map automatically on a new alarm presentation, providing the operator with prompt visual indication that an alarm has occurred.
- d. The status of intrusion devices, access control readers, doors, auxiliary monitor points, and auxiliary outputs is to be able to be requested from any map by simply selecting the icon representing the device and its current state will be displayed. CCTV camera control, digital video review, alarm panel transactions and intercom requests are to be available for inclusion on the map with the associated management module installed.

- e. Allow for SCC operators to change a current setting by pressing the right mouse button anywhere on the screen or on a specific system device icon. Pressing the right mouse button is to cause the appropriate command options list to appear for selection. Confirmation is provided by reflecting the change in status on the display after a command is selected.
- f. The display of intrusion or auxiliary door alarms may be automatically enabled or disabled by the use of timed commands, either by device or by a group of devices. This may be used, for example, to disable all door alarms on internal doors, during normal office hours.
- g. Create maps using standard office tools allowing drawings to be imported in Jpeg, Bitmap, Windows metafile, PDF or DXF file formats to provide maximum flexibility.

2.9 COMMUNICATIONS

- a. Use digital, asynchronous, or multiplexed data control unit for central alarm reporting and display processor interface. Group individual data bits into word format and transmit as coded messages. Implement interface with network switches which function as a communications controller, perform data acquisition and distribution, buffering message handling, error checking, and signal regeneration as required to maintain communications.
- b. Provide totally automatic status changes communication, commands, field initiated interrupts, and any other communications required for proper system operation. Do not require system communication operator initiation or response. System communication is to return to normal after any partial or total network interruption including power loss or transient upset. Automatically annunciate communication failures to the operator with communication link identification that has experienced a partial or total failure.

2.9.1 Link Supervision

2.9.1.1 Hardwire Direct Current Line Supervision

Provide only for the sensor to control unit links which are within the ESS protected area. Supervise circuits by monitoring changes in the current that flows through the detection circuit and a terminating resistor of at least 2.2 K ohms. Supervision circuitry is to initiate an alarm in response to opening, closing, shorting, or grounding of conductors by employing Class C standard line security. Class C circuit supervisor units are to provide an alarm response in the annunciator in not more than one second as a result of the following changes in normal transmission line current:

- a. Five percent or more in normal line signal when it consists of direct current from 0.5 through 30 milliamperes.
- b. Ten percent or more in normal line signal when it consists of direct current from 10 microamperes to 0.5 milliamperes.
- c. Five percent or more of an element or elements of a complex signal upon which security integrity of the system is dependent. This tolerance will be applied for frequencies up to 100 Hz.

- d. Fifteen percent or more of an element or elements of a complex signal upon which the security integrity of the system is dependent. This tolerance will be applicable for all frequencies above 100 Hz.

2.9.1.2 Hardwire Digital Supervision

Local processors are to exchange digital data to indicate secure or alarm at least every 2 seconds. Alarm if data is missed for more than one second for passive supervisory circuits. Coding used for data cannot be decipherable by merely viewing data on an oscilloscope. Supervisory circuits are to asynchronously transmit bursts of digital data for transponder schemes. Data pattern is to be random in nature. Remote detectors are to receive data and encode a response based on a proprietary coding scheme.

Provide a unique encoding scheme; an industry-wide or vendor standard is not acceptable. Transmit encoded response back to supervisory circuit. Supervisory circuit is to compare the response to an anticipated response. Alarm on failure of the detector to return a data burst or return an incorrect response.

2.9.2 Hardwire

2.9.2.1 Electrical Conductor Lines

- a. Use electrical conductor lines for hardwire that rely on current path except for electrical wires; neutral conductors of electrical distribution systems cannot be used as signal transmitters.
- b. Conductors outside the protected area are to be shielded cable installed in electrical metallic tubing (EMT) as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Supervision circuitry is not to initiate nuisance alarms in response to normal line noise, transients, crosstalk, or in response to normal parametric changes in the line over a temperature range of minus 30 to 125 degrees F.
- c. Ambient current levels chosen for line supervision must be sufficient to detect tampering and be within the normal operating range of electrical components. Report line supervision and tamper alarms regardless of mode of operation.
- d. Provide hardwire links as specified in UL 1076 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM for interior applications with additions and modifications specified. Conductors are to be copper. Conductors for links which also carry AC voltage, are to be No. 12 AWG minimum; single conductors for low-voltage DC links are to be No. 14 AWG minimum. Conductors are to be color coded. Conceal wiring in finished areas of new construction and wherever practical in existing construction if not otherwise precluded by the Government.
- e. Identify conductors within each enclosure where a tap, splice, or termination is made. Identify conductors by plastic-coated, self-sticking, printed markers or by heat-shrink type sleeves. Connect sensors, control units, and communication devices so that removal will cause a tamper alarm to sound. Pigtail or "T" tap connections are not acceptable. Each conductor used for identical functions is to be distinctively color-coded. Each circuit color-coded wire is to remain uniform throughout circuit. Tamper

switches meet requirements of paragraph TAMPER SWITCHES.

2.9.2.2 Communication Link

- a. Provide a dedicated circuit communication link from sensor to control unit. Opening or closing a relay contact will indicate an alarm. Convert analog signals to digital values or a relay closure or opening within 250 feet of the sensing point. Communications from control unit to central alarm reporting and display processor are to operate in a continuous interrogation and response mode, using time-multiplexed digital communications techniques.
- b. Interrogation and response communications between the control unit and central processor is to be half-duplex and bidirectional on one dual twisted pair cable (one pair for interrogation and one for response), which may have one or more parallel branches. Individual control unit lines are to be at least 22 AWG wire. Connect control wires in parallel to the hardwire link. Communication system is to provide as many as 255 control unit connections.
- c. The communication system must maintain specified performance over a link length of 4000 feet when operating without line repeaters or other signal regenerating or amplifying devices.
- d. Control unit to central alarm reporting and display processor communications link is to also be capable of operating over a maximum of two standard voice grade telephone leased or proprietary lines. Link is to be capable of operating half duplex over a Type 3002 data transmission pair and be capable of modular expansion. Telephone lines will be provided by the Government. Coordinate and check out system operation. General characteristics and telephone line service are to be as follows:

Connections	Two
Impedance at 1000 Hz	600 ohms
Transmitting level	0 to 12 dBm
Transmitting level adjustment	3 dB increments
Type	Data
Direction	Two-way alternate (half duplex)
Maximum loss at 1000 Hz	33 dB

2.9.3 Network Switch

The small form-factor pluggable (SFP) is to provide full-duplex 1000/100/10-Mbps connectivity between switches over single mode (SM) infrastructures. Provide mounting accessories for a typical cabinet. Rack requirements as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. Switch may be shared between ESS and CCTV duties.

2.9.3.1 Inside Plant

Provide a network switch for ESS system with 24 RJ-45 ethernet ports. Allow dynamic port base security and rapid spanning tree protocol with VLAN assignments for specific users regardless of where the switch is connected. The switch will use AC input voltage nominal of 120 VAC at 60 Hz. The switch is to be less than 2 Rack Units (RU) and Layer 3 capable. The switch is to have the capability of commanding a self-healing ring configuration. 1000Base-LX SFP Fast Ethernet Interface Converter (transceiver) is to be a hot swappable device that plugs into a Gigabit fiber SFP uplink port on the switch. The Mean Time Between Failure (MTBF) must be greater than 210,000 hours.

2.9.4 Video and ESS Transmission

Transmission is to be by optical fiber dedicated to the associated circuit. Video and ESS transmission cables must conform to the industry standards in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM and 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).

Install interior cable in Electrical Metallic Tubing (EMT) conduit unless indicated otherwise. Cable is to be rated for the installation method intended.

2.9.5 Wire and Cable

Provide all wire and cable not indicated as Government-furnished equipment. Wiring must meet NFPA 70 standards. Cable is to be rated for the installation method intended. If cable is to be outdoors than it shall be an outdoor rated cable.

2.9.6 Digital Data Interconnection Wiring

Interconnecting cables carrying digital data between equipment located at the SCC or at a secondary control and monitoring site is to be optical fiber cable. Interconnecting cables conform to the industry standards in Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).

2.9.7 Local Area Network (LAN) Cabling

Cabling must be in accordance with TIA-568-C.2, Category 6.

2.9.8 Cable Construction

Provide all cable components that will withstand the environment in which the cable is installed for a minimum of 20 years.

2.10 BACKUP POWER

2.10.1 Batteries

Provide backup by dedicated batteries including individual sensors or control units. Batteries are to be capable of operation in any position and be protected against venting caustic chemicals or fumes within an equipment cabinet.

2.11 SURGE SUPPRESSION DEVICES

Comply with requirements in Section 33 82 00 TELECOMMUNICATION OUTSIDE

PLANT (OSP).

2.12 COMPONENT ENCLOSURE

Alarm enclosures with a tamper switch(es). Refer to paragraph "Tamper Switch". Enclosures is to be formed and assembled to be sturdy and rigid. These include:

- a. Consoles
- b. Annunciator housings
- c. Power supply enclosures
- d. Sensor control and terminal cabinets
- e. Control units
- f. Wiring gutters
- g. Other component housings

2.12.1 Interior Enclosures

Enclosures to house equipment in an interior environment must meet the requirements of NEMA 250 Type 1.

2.12.2 Exposed-to-Weather Enclosures

Enclosures to house equipment in an outdoor environment must meet the requirements of NEMA 250 Type 4X. Interior enclosures may be housed inside exposed-to-weather enclosures to meet requirements of design.

2.12.3 Metal Thickness

Thicknesses of metal in cast and sheet metal enclosures of all types must be not less than those listed in Tables 8.1, 8.2, and 8.3 of UL 1610 for alarm components, and NEMA ICS 2 and NEMA ICS 6 for other enclosures. Sheet steel used in enclosure fabrication is to be at least 16 gage; consoles are to be at least 18 gage.

2.12.4 Doors and Covers

- a. Doors and covers are to be flanged. Provide tight pin hinges or the ends of hinge pins are to be tack welded to prevent ready removal where doors are mounted on hinges with exposed pins.
- b. Provide doors having a latch edge length of less than 24 inches with a single lock. Provide the door with a three-point latching device with lock where latch edge of a hinged door is 24 inches or more in length; or alternatively with two locks, one located near each end.
- c. The covers of provided junction boxes to facilitate initial system installation are to be held in place by tack welding, brazing, or one-way screws.

2.12.5 Ventilation

Ventilation openings in enclosures and cabinets must conform to

requirements of UL 1610.

2.12.6 Mounting

Sheet metal enclosures are to be rated for wall mounting with top hole slotted, unless otherwise indicated. Mounting holes are to be in positions which remain accessible when major operating components are in place and door is open, and be inaccessible when door is closed.

2.12.7 Labels

Label boxes containing connections that they contain ESS connections and indicate that the box is part of the ESS system.

2.12.8 Test Points

Provide readily visible and accessible with minimum disassembly of equipment to test points, controls, and other adjustments inside enclosures. Test points and other maintenance controls must be readily accessible to operator personnel.

2.13 LOCKS AND KEY LOCK

2.13.1 Lock

Provide locks on system enclosures for maintenance purposes that meet UL 437 and are conventional key type lock having a five cylinder pin and five-point three position side bar combination. Keys must be stamped "U.S. GOVT. DO NOT DUP.". Keys are only to be withdrawn when in the locked position. Key all maintenance locks alike and furnish only two keys for all of these locks.

2.13.2 Construction Locks

Use a set of temporary locks during installation and construction. Do not include any of the temporary locks in the final set of locks installed and delivered to the Government.

2.14 FIELD FABRICATED NAMEPLATES

Nameplates must comply with ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription is to identify the function and, when applicable, the position.

Name plates for all exposed out door equipment must be located on the inside of the enclosure. Posting enclosure identification data on the outside is unacceptable.

Nameplates are to be melamine plastic, 0.125 inch thick, white with black center core. Surface is to be matte finish. Corners are to be square. Accurately align lettering and engrave into the core. Minimum size of nameplates must be 1 by 2.5 inches. Provide lettering a minimum of 0.25 inch high normal block style. Nameplates are not be required for devices smaller than 1 x 3 inches.

2.14.1 Manufacturer's Nameplate

Each item of equipment is to have a nameplate bearing the manufacturer's

name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.15 FACTORY APPLIED FINISH

Electrical equipment is to have factory-applied painting systems which meets the requirements of the NEMA 250 corrosion-resistance test as a minimum.

PART 3 EXECUTION

3.1 INSTALLATION

Install the system in accordance with safety and technical standards NFPA 70, UL 681, UL 1037, and UL 1076. Configure components within the system with appropriate service points to pinpoint system trouble in less than 20 minutes.

Install all system components, including any equipment that is furnished by the Government, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown on the drawings, and furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

3.1.1 Existing Equipment

Connect to and utilize existing equipment, control signal transmission lines, and devices as shown on the drawings. Any equipment and signal lines that are usable in their original configuration without modification may be reused with Government approval.

Make written requests and obtain approval prior to disconnecting any signal lines and equipment that creates equipment outage. Such work can proceed only after receiving Government approval of these requests. If any device fails after work has commenced on that device, signal, or control line, diagnose the failure and perform any necessary corrections to the equipment. The Government is responsible for maintenance and repair of Government equipment. The Contractor will be held responsible for repair costs due to negligence or abuse of Government equipment on their part.

3.1.2 Software Installation

Load software as specified and required for an operational system, including databases and specified programs. Provide original and backup copies on optic discs of all accepted software, including diagnostics, upon successful endurance test completion. Turn over to NOAA representative via the construction officer (CO).

3.1.3 Enclosure Penetrations

Enclosures are to be penetrated from the bottom unless shown otherwise. Penetrations of interior enclosures having transitions of conduit from interior to exterior, and penetrations of exterior enclosures are to be sealed with rubber silicone sealant to preclude the entry of water. Terminate conduit risers in a hot-dipped galvanized metal cable terminator that is filled with a sealant as recommended by the cable manufacturer, and in a manner that does not damage the cable.

3.1.4 Cable and Wire Runs

Perform required cable and wire routings per NFPA 70 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, and as specified. Terminate conduits including flexible metal and armored cable in the sensor or device enclosure. Fit ends of conduit with insulated bushings. Exposed conductors at ends of conduits external to sensors and devices are not acceptable.

3.1.5 Soldering

Soldered electrical connections must use composition Sn60, Type AR or S, for general purposes; use composition Sn62 or Sn63, Type AR or S, for special purposes. Flux must conform to ASTM B32 when Type S solder is used for soldering electrical connections.

3.1.6 Galvanizing

Ferrous metal is to be hot-dip galvanized in accordance with ASTM A123/A123M. Provide screws, bolts, nuts, and other fastenings and supports that are corrosion resistant.

Field welds or brazing on factory galvanized boxes, enclosures, conduits, and so on, are to be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.1.7 Conduits

Install interior conduits in accordance with NFPA 70, Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install exterior conduits in accordance with NFPA 70, Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.1.8 Underground Cable Installation

Install underground conductors connecting protected structures and objects to the central alarm updating and display unit as direct burial or in conduit as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Coaxial cable cannot be spliced.

3.1.9 Camera Housings, Mounts, and Poles

- a. Provide a foundation for each camera pole as specified and designed.

3.1.10 Field Applied Painting

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting must be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 ADJUSTMENT, ALIGNMENT, SYNCHRONIZATION, AND CLEANING

- a. Clean each system component of dust, dirt, grease, or oil incurred during and after installation or accrued subsequent to installation from other project activities subsequent to installation.
- b. Prepare for system activation by manufacturer's recommended procedures for adjustment, alignment, or synchronization.

- c. Prepare each component in accordance with appropriate provisions of component installation, operations, and maintenance manuals.
- d. Remove large vegetation that may sway in the wind and touch fencing.
- e. Adjust sensors so that coverage is maximized without mutual interference.

3.3 SYSTEM STARTUP

Do not apply power to the system until after:

- a. Set up system equipment items and communications in accordance with manufacturer's instructions.
- b. Conduct a system visual inspection to ensure that defective equipment items have not been installed and that there are no loose connections.
- c. Test and verify system wiring as correctly connected.
- d. Verify system grounding and transient protection systems as properly installed.
- e. Verify the correct voltage, phasing, and frequency of the system power supplies.

Satisfaction of the requirements above does not relieve the contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as result of Contractor work or equipment.

3.4 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL

Provide the services of technical representatives who are familiar with all components and installation procedures of the installed system; and are approved by the Contracting Officer. These representatives are to be present on the job site during the preparatory and initial phases of quality control to provide technical assistance. These representatives are also to be available on an as needed basis to provide assistance with follow-up phases of quality control. These technical representatives are to participate in the system testing and validation and provide certification that their respective system portions meet the contractual requirements.

The above requirements supplement the quality control requirements specified elsewhere in the contract.

3.5 ESS SYSTEM TESTING

All ESS Testing requirements are specified in Section 28 08 10 ELECTRICAL SECURITY SYSTEM ACCEPTANCE TESTING.

3.6 ESS TRAINING

Conduct training courses for 10 designated personnel in system maintenance and operation. Coordinate training with the Government. The training is to be oriented to the specific system being installed. Training content is to include training manuals and audio-visual materials. Deliver training manuals for each trainee with 2 additional copies delivered for archiving at the project site. The manuals are to include an agenda,

defined objectives for each lesson, and a detailed subject matter description for each lesson.

Furnish audio-visual equipment and other training materials and supplies. Deliver copies of the audio-visual materials to the Government either as a part of the printed training manuals or on the same media as that used during the training sessions when course portions are presented using audio-visual material.

3.6.1 ESS Training Outline

Submit a training plan for the training phases, including type of training to be provided, outline of training manuals, training course agendas, and a list of reference material, for Government approval.

3.6.2 Typical Training Day

A training day is defined as:

- a. Eight hours of classroom instruction, with
 - (1) Two 15-minute breaks
 - (2) One hour lunch break
- b. Conducted:
 - (1) Monday through Friday
 - (2) During the daytime shift in effect at a Government-provided training facility

For guidance in planning the required instruction, assume that attendees will have a high school education or equivalent, and are familiar with ESS. Approval of the planned training schedule is to be obtained from the Government at least 30 days prior to the training.

3.6.3 ESS Administrator Training

- a. ACS and IDS Administrator Training includes:
 - (1) One eight-hour on-site training session
 - (2) Operating system procedures and configuration
 - (3) Operator functions
 - (4) Database functions and setup
 - (5) Card holder input and deletion procedures
 - (6) Report generation
 - (7) Applications programs (as applicable)
 - (8) Graphics generation and manipulation
 - (9) Items unique to the ACS and IDS interfaces with other systems

(10) System backup and restore

b. CCTV System Administrator Training includes:

(1) One eight-hour session on site

(2) Training is to include all administrator and operator functions, and items unique to the installed CCTV System, and interfaces with other systems.

3.6.4 ESS Operator Training

Coordinate the operator training syllabus with the Government prior to conducting operator training.

a. ACS and IDS Operator Training includes:

(1) One (one-day) 8 hour on-site training session

(2) System operating procedures

(3) System configuration orientation

(4) Alarm acknowledgment

(5) Alarm response logging

(6) Graphics functionality

(7) Items unique to the ACS and IDS interfaces with other systems

b. CCTV Operator Training includes:

(1) One (one-day) 8 hour on-site training sessions

(2) System operating procedures

(3) System configuration

(4) Video call-up

(5) Camera and monitor control

(6) Graphics functionality

(7) Basic device terminology and troubleshooting

3.6.5 Maintenance Personnel Training

The system maintenance course is to be taught at the project site after endurance test completion for a period of five training days. A maximum of five personnel, designated by the Government, will attend the course. The training includes:

a. Physical layout of each piece of hardware.

b. Troubleshooting and diagnostics procedures.

c. Component repair and replacement procedures.

- d. Maintenance procedures and schedules to include system testing after repair.
- e. Calibration procedures. Upon course completion, the students are to be proficient in system maintenance.
- f. Review of site-specific drawing package, device location, communication, topology, and flow.

3.7 NAMEPLATE MOUNTING

Provide nameplate number, location, and letter designation as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or rivets.

-- End of Section --

SECTION 28 31 76

INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S3.2 (2009; R 2014) Method for Measuring the
Intelligibility of Speech Over
Communication Systems (ASA 85)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A17.1/CSA B44 (2021) Safety Code for Elevators and
Escalators

ASTM INTERNATIONAL (ASTM)

ASTM F402 (2005; R 2012) Safe Handling of Solvent
Cements, Primers, and Cleaners Used for
Joining Thermoplastic Pipe and Fittings

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1 (2002; R 2008) Guide on the Surges
Environment in Low-Voltage (1000 V and
Less) AC Power Circuits

IEEE C62.41.2 (2002) Recommended Practice on
Characterization of Surges in Low-Voltage
(1000 V and Less) AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 4 (2018) Standard for Integrated Fire
Protection and Life Safety System Testing

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 72 (2019) National Fire Alarm and Signaling
Code

NFPA 90A (2021) Standard for the Installation of
Air Conditioning and Ventilating Systems

NFPA 170 (2021) Standard for Fire Safety and
Emergency Symbols

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01 (2020; with Change 5) Fire Protection
Engineering for Facilities

UFC 3-601-02 (2010) Operations and Maintenance:
Inspection, Testing, and Maintenance of
Fire Protection Systems

UFC 4-010-06 (2016; with Change 1, 2017) Cybersecurity
of Facility-Related Control Systems

UFC 4-021-01 (2008; with Change 1, 2010) Design and
O&M: Mass Notification Systems

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15 Radio Frequency Devices

47 CFR 90 Private Land Mobile Radio Services

UNDERWRITERS LABORATORIES (UL)

UL 268 (2016; Reprint Oct 2019) UL Standard for
Safety Smoke Detectors for Fire Alarm
Systems

UL 268A (2008; Reprint Oct 2014) Smoke Detectors
for Duct Application

UL 464 (2016; Reprint Sep 2017) UL Standard for
Safety Audible Signaling Devices for Fire
Alarm and Signaling Systems, Including
Accessories

UL 497A (2001; Bul. 2019) UL Standard for Safety
Secondary Protectors for Communications
Circuits

UL 497B (2004; Reprint Dec 2012) Protectors for
Data Communication Circuits

UL 864 (2014; Reprint May 2020) UL Standard for
Safety Control Units and Accessories for
Fire Alarm Systems

UL 1283 (2017) UL Standard for Safety
Electromagnetic Interference Filters

UL 1449 (2014; Reprint Jul 2017) UL Standard for
Safety Surge Protective Devices

UL 1480 (2016; Reprint Sep 2017) UL Standard for

Safety Speakers for Fire Alarm and
Signaling Systems, Including Accessories

UL 1638	(2016; Reprint Sep 2017) UL Standard for Safety Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
UL 1971	(2002; Reprint Oct 2008) Signaling Devices for the Hearing Impaired
UL 2034	(2017; Reprint Sep 2018) UL Standard for Safety Single and Multiple Station Carbon Monoxide Alarms
UL 2075	(2013; Bul. 2019) UL Standard for Safety Gas and Vapor Detectors and Sensors
UL 2572	(2016; Bul. 2018) UL Standard for Safety Mass Notification Systems
UL Fire Prot Dir	(updated continuously online) Fire Protection Equipment Directory

1.2 RELATED SECTIONS

Section 25 05 11.01 Cybersecurity for Building Automation Systems, applies to this section, with the additions and modifications specified herein. In addition, refer to the following sections for related work and coordination:

Section 21 22 00.00 40 CLEAN AGENT FIRE EXTINGUISHING SYSTEMS
Section 21 13 13 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION
Section 21 30 00 FIRE PUMPS
Section 14 24 23 HYDRAULIC PASSENGER ELEVATORS for additional work related to elevators.
Section 07 84 00 FIRESTOPPING for additional work related to firestopping.

1.3 SUMMARY

1.3.1 Scope

- a. This work includes designing and providing a new, complete, fire alarm and mass notification (MNS) system as described herein and on the contract drawings. Include system wiring, raceways, pull boxes, outlet and mounting boxes, control equipment, initiating devices, notification appliances, supervising station fire alarm transmitters/mass notification transceiver, and other accessories and miscellaneous items required for a complete operational system even though each item is not specifically mentioned or described. Provide system complete and ready for operation. Design and installation must comply with UFGS 25 05 11.01, UFC 3-600-01, UFC 4-021-01, and UFC 4-010-06.
- b. Provide equipment, materials, installation, workmanship, inspection, and testing in strict accordance with NFPA 72, except as modified herein.

- c. A fire pump is provided, the fire alarm and mass notification system must monitor and transmit the fire pump controller signals in accordance with the provisions of NFPA 72.
- d. An emergency generator provides standby power supply for life safety system circuits, the generator must be monitored by the FACU/ACU and transmit emergency generator signals in accordance with NFPA 72.
- e. The fire alarm and mass notification system must be independent of the building security, building management, and energy/utility monitoring systems other than for control functions.

1.3.2 Qualified Fire Protection Engineer (QFPE)

Services of the QFPE must include:

- a. Reviewing SD-02, SD-03, and SD-05 submittal packages for completeness and compliance with the provisions of this specification. The QFPE must review the shop drawings, calculations, and material data sheets, and must bear the review stamp of the QFPE indicating approval prior to submitting the shop drawings to the DFPE.
- b. Providing a letter documenting that the SD-02, SD-03, and SD-05 submittal package has been reviewed and noting any outstanding comments.
- c. Performing in-progress construction surveillance prior to installation of ceilings (rough-in inspection).
- d. Witnessing pre-Government and final Government functional performance testing and performing a final installation review where required by the Contracting Officer.

1.4 DEFINITIONS

Wherever mentioned in this specification or on the contract drawings, the equipment, devices, and functions must be defined as follows:

1.4.1 Interface Device

An addressable device that interconnects hard wired systems or devices to an analog/addressable system.

1.4.2 Fire Alarm and Mass Notification Control Unit (FACU/ACU)

A master control unit having the features of a fire alarm control unit (FACU) and an autonomous control unit (ACU) where these units are interconnected to function as a combined fire alarm/mass notification system. The FACU and ACU functions may be contained in a single cabinet or in independent, interconnected, and co-located cabinets.

1.4.3 Local Operating Console (LOC)

A unit designed to allow emergency responders and/or building occupants to operate the MNS including delivery of recorded messages and/or live voice announcements, initiate visual, textual visual, and audible appliance operation and other relayed functions.

1.4.4 Control Module and Relay Module

Terms utilized to describe emergency control function interface devices as defined by NFPA 72.

1.4.5 Designated Fire Protection Engineer (DFPE)

The DoD fire protection engineer that oversees that Area of Responsibility for that project. This is sometimes referred to as the "cognizant" fire protection engineer. Interpret reference to "authority having jurisdiction" and/or AHJ in referenced standards to mean the Designated Fire Protection Engineer (DFPE). The DFPE may be responsible for review of the contractor submittals having a "G" designation, and for witnessing final inspection and testing.

1.4.6 Qualified Fire Protection Engineer (QFPE)

A QFPE is an individual who is a licensed professional engineer (P.E.), who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) and has relevant fire protection engineering experience.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING.

Shop drawings (SD-02), product data (SD-03) and calculations (SD-05) must be prepared and signed by the Fire Alarm System Designer and combined and submitted as one complete package. The QFPE must review the SD-02/SD-03/SD-05 submittal package for completeness and compliance with the Contract provisions prior to submission to the Government. The QFPE must provide a Letter of Confirmation that they have reviewed the submittal package for compliance with the contract provisions. This letter must include their professional engineer stamp and signature. Partial submittals and submittals not reviewed by the QFPE will be returned by the Government disapproved without review.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualified Fire Protection Engineer (QFPE); G

Fire alarm system designer; G

Supervisor; G

Technician; G

Installer; G

Test Technician; G

Fire Alarm System Site-Specific Software Acknowledgement; G

SD-02 Shop Drawings

Nameplates; G

Instructions; G

Wiring Diagrams; G

System Layout; G

Notification Appliances; G

Initiating devices; G

Amplifiers; G

Battery Power; G

Voltage Drop Calculations; G

Radio Transmitter and Interface Panels; G

SD-03 Product Data

Fire Alarm and Mass Notification Control Unit (FACU/ACU); G

Local Operating Console (LOC); G

Amplifiers; G

LCD Annunciator; G

Manual Stations; G

Smoke Detectors; G

Duct Smoke Detectors; G

Air sampling smoke detectors; G

Carbon monoxide detector; G

Addressable Interface Devices; G

Addressable Control Modules; G

Isolation Modules; G

Notification Appliances; G

Textual Display Sign Control Panel; G

Textual Display Signs; G

Batteries; G

Battery Chargers; G

Supplemental Notification Appliance Circuit Panels; G

Auxiliary Power Supply Panels; G

Surge Protective Devices; G

Alarm Wiring; G

Ceiling Bridges for Ceiling-Mounted Appliances; G

Automatic Fire Alarm Transmitters (including housing); G

Mass Notification Transceiver; G

Document Storage Cabinet; G

SD-05 Design Data

Air Sampling Smoke Detection System Calculations; G

SD-06 Test Reports

Test Procedures; G

SD-07 Certificates

Verification of Compliant Installation; G

Request for Government Final Test; G

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G

Instruction of Government Employees; G

SD-11 Closeout Submittals

As-Built Drawings; G

Spare Parts; G

1.6 SYSTEM OPERATION

Fire alarm system/mass notification system including textual display sign control panel(s), components requiring power, except for the FACU/ACU(s) power supply, must operate on 24 volts DC unless noted otherwise in this section.

The interior fire alarm and mass notification system must be a complete, supervised, noncoded, analog/addressable fire alarm and mass notification system conforming to NFPA 72, UL 864, and UL 2572. Systems meeting UL 2017 only are not acceptable. The system must be activated into the alarm mode by actuation of an alarm initiating device. The system must remain in the alarm mode until the initiating device is reset and the control unit is reset and restored to normal. The system may be placed in the alarm mode by local microphones, LOC, FACU/ACU, or remotely from authorized locations/users.

1.6.1 Alarm Initiating Devices and Notification Appliances (Visual, Voice, Textual)

- a. Connect alarm initiating devices to initiating device circuits (IDC) Class "B", or to signaling line circuits (SLC) Class "B" and installed in accordance with NFPA 72.
- b. Connect notification appliances to notification appliance circuits (NAC) Class "B". Connect speakers to speaker circuits Class "B".

1.6.2 Functions and Operating Features

The system must provide the following functions and operating features:

- a. Power, annunciation, supervision, and control for the system. Addressable systems must be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits with sufficient memory to perform as specified.
- b. Visual alarm notification appliances must be synchronized as required by NFPA 72.
- c. Electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control unit.
- d. An audible and visual trouble signal to activate upon a single break or open condition, or ground fault. The trouble signal must also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, or removal of alarm or supervisory control unit modules. After the system returns to normal operating conditions, the trouble signal must again sound until the trouble is acknowledged. A smoke detector in the process of being verified for the actual presence of smoke must not initiate a trouble condition.
- e. A trouble signal silence feature that must silence the audible trouble signal, without affecting the visual indicator.
- f. Alarm functions must override trouble or supervisory functions. Supervisory functions must override trouble functions.
- g. The system must be capable of being programmed from a laptop with the system software. Programmed information must be stored in non-volatile memory.
- h. The system must be capable of operating, supervising, and/or monitoring non-addressable alarm and supervisory devices.
- i. There must be no limit, other than maximum system capacity, as to the number of addressable devices that may be in alarm simultaneously.
- j. Where the fire alarm/mass notification system is responsible for initiating an action in another emergency control device or system, such as HVAC, elevator recall, or releasing service, the addressable fire alarm relay must be located in the vicinity of the emergency control device.
- k. An alarm signal must automatically initiate the following functions:

- (1) Transmission of an alarm signal to the fire department.
 - (2) Visual indication of the device operated on the FACU/ACU, and on the remote annunciator. Indication be by floor, zone or circuit, and type of device.
 - (3) Actuation of alarm notification appliances.
 - (4) Recording of the event electronically in the history log of the FACU/ACU.
 - (5) Elevator recall as described in this section.
 - (6) Actuation of first floor telecom room air aspirating detection system must send a signal to the first floor telecom room clean agent releasing panel to release the associated Clean Agent fire extinguishing system after a 60 second time delay. The air aspirating detection system installed in the second floor telecom room must operate in the same manner, but must send it's signal to the second floor telecom room clean agent releasing panel.
 - (7) Operation of a sprinkler waterflow switch serving an elevator machinery room or elevator shaft must operate shunt trip circuit breaker(s) to shut down power to the elevators in accordance with ASME A17.1/CSA B44.
 - (8) Refer to the contract drawings for additional alarm requirements.
- l. A supervisory signal must automatically initiate the following functions:
 - (1) Visual indication of the device operated on the FACU/ACU, and on the remote annunciator. Indication must be by floor, zone or circuit, and type of device.
 - (2) Transmission of a supervisory signal to the fire department.
 - (3) Operation of a duct smoke detector must shut down the appropriate air handler in accordance with NFPA 90A in addition to other requirements of this paragraph and as allowed by NFPA 72.
 - (4) Recording of the event electronically in the history log of the FACU/ACU.
 - (5) Refer to the contract documents for additional supervisory requirements.
 - m. A trouble condition must automatically initiate the following functions:
 - (1) Visual indication of the device operated on the FACU/ACU, and remote annunciator. Indication must be by floor, zone or circuit, and type of device.
 - (2) Transmission of a trouble signal to the fire department.
 - (3) Recording of the event electronically in the history log of the FACU/ACU.

- (4) Refer to the contract documents for additional trouble requirements.
- n. Activation of a carbon monoxide alarm initiating device must automatically initiate the following functions:
 - (1) Visual indication of the device operated on the FACU/ACU and on the remote annunciator. Indication must be by floor and room number, device address, and device type.
 - (2) Transmission of a carbon monoxide alarm signal to the fire department.
 - (3) Activation of the audible carbon monoxide message throughout the building.
 - (4) Recording of the event electronically in the history log of the FACU/ACU.
- o. System control equipment must be programmed to provide a 60-minute to 180-minute delay in transmission of trouble signals resulting from primary power failure.
- p. Activation of a LOC pushbutton must activate the audible and visual alarms in the facility. The audible message must be the one associated with the pushbutton activated.

1.6.3 Elevator Recall

Provide elevator recall in accordance with ASME A17.1/CSA B44, Section 14 24 23 HYDRAULIC PASSENGER ELEVATORS, and as specified herein. Activation of any smoke detector in an elevator shaft, machine room, or lobby (except at designated recall level) must cause all elevators associated with that shaft, machine room, or lobby to return nonstop to the designated level. Activation of a smoke detector in the lobby or machine room at the designated level must cause all elevators associated with that lobby to return nonstop to the assigned alternate level. Activation of a detector in an elevator shaft, machine room, or lobby must also cause illumination of elevator cab warning signal (fire hat) and complete operation of fire alarm system as specified in paragraph titled "Functions and Operating Features".

1.7 TECHNICAL DATA AND SITE-SPECIFIC SOFTWARE

Technical data and site-specific software (meaning technical data that relates to computer software) that are specifically identified in this project, and may be required in other specifications, must be delivered, strictly in accordance with the CONTRACT CLAUSES. The fire alarm system manufacturer must submit written confirmation of this contract provision as "Fire Alarm System Site-Specific Software Acknowledgement". Identify data delivered by reference to the specification paragraph against which it is furnished. Data to be submitted must include complete system, equipment, and software descriptions. Descriptions must show how the equipment will operate as a system to meet the performance requirements of this contract. The site-specific software data package must also include the following:

- a. Items identified in NFPA 72, titled "Site-Specific Software".

- b. Identification of programmable portions of the system equipment and capabilities.
- c. Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.
- d. Provision of operational software data on all modes of programmable portions for fire alarm and mass notification.
- e. Description of Fire Alarm and Mass Notification Control Unit equipment operation.
- f. Description of auxiliary and remote equipment operations.
- g. Library of application software.
- h. Operation and maintenance manuals.

1.8 EXISTING EQUIPMENT

- a. Equipment and devices must not impair reliability or operational functions of existing supervising station fire alarm system. The head end fire alarm reporting system is Digitize 3505.
- b. Equipment and devices must be compatible and operable with the existing installation-wide mass notification system and must not impair reliability or operational functions of the existing system. The installation-wide mass notification system utilizes Federal Signal transceivers.

1.9 QUALITY ASSURANCE

1.9.1 Submittal Documents

1.9.1.1 Preconstruction Submittals

Within 36 days of contract award but not less than 14 days prior to commencing any work on site, the Contractor must submit the following for review and approval. SD-02, SD-03 and SD-05 submittals received prior to the review and approval of the qualifications of the fire alarm subcontractor and QFPE must be returned disapproved without review. All resultant delays must be the sole responsibility of the Contractor.

1.9.1.2 Shop Drawings

Shop drawings must not be smaller than ANSI D. Drawings must comply with the requirements of NFPA 72 and NFPA 170. Minimum scale for floor plans must be 1/8"=1'.

1.9.1.3 Nameplates

Nameplate illustrations and data to obtain approval by the Contracting Officer before installation.

1.9.1.4 Wiring Diagrams

Three copies of point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the

system, including interconnections between the equipment or systems that are supervised or controlled by the system. Diagrams must show connections from field devices to the FACU/ACU and remote FACU/ACU, initiating circuits, switches, relays and terminals, including pathway diagrams between the control unit and shared communications equipment within the protected premises. Point-to-point wiring diagrams must be job specific and must not indicate connections or circuits not being utilized. Provide complete riser diagrams indicating the wiring sequence of all devices and their connections to the control equipment. Include a color-code schedule for the wiring.

1.9.1.5 System Layout

Three copies of plan view drawing showing device locations, junction boxes, other related equipment, conduit routing, conduit sizes, wire counts, conduit fill calculations, wire color-coding, circuit identification in each conduit, and circuit layouts for all floors. Indicate candela rating of each visual notification appliance. Indicate the wattage of each speaker. Clearly identify the locations of isolation modules. Indicate the addresses of all devices, modules, relays, and similar. Show/identify all acoustically similar spaces. Indicate if the environment for the FACU/ACU is within its environmental listing (e.g. temperature/humidity).

Provide a complete description of the system operation in matrix format similar to the "Typical Input/Output Matrix" included in the Annex of NFPA 72.

For air sampling smoke detection systems, provide floor plan layouts indicating location of air sampling smoke detector, air sampling piping (lengths of pipe) and sampling ports (sizes and locations). Floor plan must also indicate geographic monitor zone boundaries, location of display control unit, bar level annunciation panels if separate, and all other associated equipment that is required to provide a complete operational system.

1.9.1.6 Notification Appliances

Calculations and supporting data on each circuit to indicate that there is at least 25 percent spare capacity for notification appliances. Annotate data for each circuit on the drawings.

1.9.1.7 Initiating Devices

Calculations and supporting data on each circuit to indicate that there is at least 25 percent spare capacity for initiating devices. Annotate data for each circuit on the drawings.

1.9.1.8 Amplifiers

Calculations and supporting data to indicate that amplifiers have sufficient capacity to simultaneously drive all notification speakers at tapped settings plus 25 percent spare capacity. Annotate data for each circuit on the drawings.

1.9.1.9 Battery Power

Calculations and supporting data as required in paragraph Battery Power Calculations for alarm, alert, and supervisory power requirements.

Calculations including ampere-hour requirements for each system component and each control unit component, and the battery recharging period, must be included on the drawings.

1.9.1.10 Voltage Drop Calculations

Voltage drop calculations for each notification circuit indicating that sufficient voltage is available for proper operation of the system and all components, at a minimum rated voltage of the system operating on batteries. Include the calculations on the system layout drawings.

1.9.1.11 Product Data

Three copies of annotated descriptive data to show the specific model, type, and size of each item. Catalog cuts must also indicate the NRTL listing. The data must be highlighted to show model, size, and options that are intended for consideration. Data must be adequate to demonstrate compliance with all contract requirements. Product data for all equipment must be combined into a single submittal.

Provide an equipment list identifying the type, quantity, make, and model number of each piece of equipment to be provided under this submittal. The equipment list must include the type, quantity, make and model of spare equipment. Types and quantities of equipment submitted must coincide with the types and quantities of equipment used in the battery calculations and those shown on the shop drawings.

1.9.1.12 Air Sampling Smoke Detection System Calculations

Submit air sampling detection system design analysis calculations consisting of battery capacity, loading calculations, and fan speed and air flow/transport calculations. Include schematic diagrams showing pipe segments, pipe diameters, lengths of pipe, node numbers, and sample port diameters to verify the requirements are met.

1.9.1.13 Operation and Maintenance (O&M) Instructions

Six copies of the Operation and Maintenance Instructions. The O&M Instructions must be prepared in a single volume or in multiple volumes, with each volume indexed, and may be submitted as a Technical Data Package. Manuals must be approved prior to training. The Interior Fire Alarm And Mass Notification System Operation and Maintenance Instructions must include the following:

- a. "Manufacturer Data Package five" as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA.
- b. Operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual must include the manufacturer's name, model number, service manual, parts list, and preliminary equipment list complete with description of equipment and their basic operating features.
- c. Maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals must include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed.
- d. Complete procedures for system revision and expansion, detailing both

equipment and software requirements.

- e. Software submitted for this project on CD/DVD media utilized.
- f. Printouts of configuration settings for all devices.
- g. Routine maintenance checklist. The routine maintenance checklist must be arranged in a columnar format. The first column must list all installed devices, the second column must state the maintenance activity or state no maintenance required, the third column must state the frequency of the maintenance activity, and the fourth column provided for additional comments or reference. All data (devices, testing frequencies, and similar) must comply with UFC 3-601-02.
- h. A final Equipment List must be submitted with the Operating and Maintenance (O&M) manual.

1.9.1.14 As-Built Drawings

The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final Government test of the system. At least one set of the as-built (marked-up) drawings must be provided at the time of, or prior to the final Government test.

1.9.2 Qualifications

1.9.2.1 Fire Alarm System Designer

The fire alarm system designer must be certified as a Level IV (minimum) Technician by National Institute for Certification in Engineering Technologies (NICET) in the Fire Alarm Systems subfield of Fire Protection Engineering Technology or meet the qualifications for a QFPE.

Working (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of, the Fire Alarm System Designer and must be signed by the Fire Alarm System Designer. Services of the Fire Alarm System Designer must also include:

- a. Performing in-progress construction surveillance prior to installation of ceilings (rough-in inspection).
- b. Signing applicable certificates under SD-07.

1.9.2.2 Supervisor

A NICET Level III fire alarm technician must supervise the installation of the fire alarm/mass notification system, including the air sampling smoke detection system. The fire alarm technicians supervising the installation of equipment must be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the contract drawings.

1.9.2.3 Technician

Fire alarm technicians with a minimum of four years of experience must be utilized to install and terminate fire alarm/mass notification devices, cabinets and control units. The fire alarm technicians installing the equipment must be factory trained in the installation, adjustment,

testing, and operation of the equipment specified herein and on the drawings, and must be thoroughly experienced in the installation of air sampling detection systems.

1.9.2.4 Installer

A NICET Level II technician must assist in the installation of fire alarm/mass notification devices, cabinets and control units. A licensed electrician must be allowed to install wire, cable, conduit and backboxes for the fire alarm system/mass notification system as approved by the Fire Alarm Contractor. The fire alarm installer must be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the contract drawings.

1.9.2.5 Test Technician

Fire alarm technicians with a minimum of eight years of experience and NICET Level IV must be utilized in testing and certification of the installation of the fire alarm/mass notification devices, cabinets and control units. The fire alarm technicians testing the equipment must be factory trained in the installation, adjustment, testing, and operation of the equipment installed as part of this project.

1.9.2.6 Manufacturer

Components must be of current design and must be in regular and recurrent production at the time of installation. Provide design, materials, and devices for a protected premises fire alarm system, complete, conforming to NFPA 72, except as specified herein.

1.9.3 Regulatory Requirements

Equipment and material must be listed or approved. Listed or approved, as used in this Section, means listed, labeled or approved by a Nationally Recognized Testing Laboratory (NRTL) such as UL Fire Prot Dir or FM APP GUIDE. The omission of these terms under the description of any item of equipment described must not be construed as waiving this requirement. All listings or approvals by testing laboratories must be from an existing ANSI or UL published standard. The recommended practices stated in the manufacturer's literature or documentation must be considered as mandatory requirements.

1.10 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants.

1.11 MAINTENANCE

1.11.1 Spare Parts

Furnish the following spare parts in the manufacturers original unopened containers:

- a. Five complete sets of system keys.
- b. Two of each type of fuse required by the system.
- c. One manual stations.

- d. Two of each type of detector installed.
- e. Two of each type of detector base and head installed.
- f. Two air sampling smoke detection system filter assemblies.
- g. Two of each type of audible and visual alarm device installed.
- h. One textual visual notification appliance.
- i. Two of each type of addressable monitor module installed.
- j. Two of each type of addressable control module installed.
- k. One 120 VAC surge protective device.

1.11.2 Special Tools

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment must be furnished to the Contracting Officer, prior to the instruction of Government employees.

PART 2 PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENT

All fire alarm and mass notification equipment must be listed for use under the applicable reference standards. Interfacing of UL 864 or similar approved industry listing with Mass Notification equipment listed to UL 2572 must be done in a laboratory listed configuration, if the software programming features cannot provide a listed interface control.

2.2 MATERIALS AND EQUIPMENT

2.2.1 Standard Products

Provide materials, equipment, and devices that have been tested by a nationally recognized testing laboratory and listed for fire protection service when so required by NFPA 72 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for any particular classification of materials. Material and equipment must be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening.

2.2.2 Nameplates

Major components of equipment must have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new name plate permanently affixed to the item or equipment. Major components include, but are not limited to, the following:

- a. FACU/ACU

Nameplates must be etched metal or plastic, permanently attached by screws

to control units or adjacent walls.

2.2.3 Keys

Keys and locks for equipment, control units and devices must be identical. Master all keys and locks to a single key as required by the Contracting Officer.

2.2.4 Instructions

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the instructions on the interior of the FACU/ACU. The card must show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions must also include procedures for operating live voice microphones. The instructions and their mounting location must be approved by the Contracting Officer before being posted.

2.3 FIRE ALARM AND MASS NOTIFICATION CONTROL UNIT

Provide a complete fire alarm and mass notification control unit (FACU/ACU) fully enclosed in a lockable steel cabinet as specified herein. Operations required for testing or for normal care, maintenance, and use of the system must be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control unit, the unit cabinets must match exactly. The system must be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling such as waterflow switches, valve supervisory switches, fire pump monitoring, independent smoke detection systems, relays for output function actuation.

- a. Each control unit must provide power, supervision, control, and logic for the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit must be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each control unit with supervisory functions for power failure, internal component placement, and operation.
- b. Visual indication of alarm, supervisory, or trouble initiation on the FACU/ACU must be by liquid crystal display or similar means with a minimum of 80 characters. The mass notification control unit must have the capability of temporarily deactivate the fire alarm audible notification appliances while delivering voice messages.
- c. Provide secure operator console for initiating recorded messages, strobes and displays; and for delivering live voice messages. Provide capacity for at least eight prerecorded messages. Provide the ability to automatically repeat prerecorded messages. Provide a secure microphone for delivering live messages. Provide adequate discrete outputs to temporarily deactivate fire alarm audible notification, initiate/synchronize strobes and initiate textual visual notification appliances. Provide a complete set of self-diagnostics for controller and appliance network. Provide local diagnostic information display and local diagnostic information and system event log file.

2.3.1 Cabinet

Install control unit components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of control units as well as field wiring. The cabinet must be a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions. The enclosure must be identified by an engraved phenolic resin nameplate. Lettering on the nameplate must say "Fire Alarm and Mass Notification control unit" and must not be less than 1-inch high. Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches.

2.3.2 Silencing Switches

2.3.2.1 Alarm Silencing Switch

Provide an alarm silencing switch at the FACU/ACU that must silence the audible and visual notification appliances. Subsequent activation of initiating devices must cause the notification appliances to re-activate.

2.3.2.2 Supervisory/Trouble Silencing Switch

Provide supervisory and trouble silencing switch(es) that must silence the audible trouble and supervisory signal(s), but not extinguish the visual indicator. This switch must be overridden upon activation of a subsequent supervisory or trouble condition. Audible trouble indication must resound automatically every 24 hours after the silencing feature has been operated if the supervisory or trouble condition still exists.

2.3.3 Non-Interfering

Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Initiating devices must be manually reset by switch from the FACU/ACU after the initiating device or devices have been restored to normal.

2.3.4 Audible Notification System

The Audible Notification System must comply with the requirements of NFPA 72 for Emergency Voice/Alarm Communications System requirements, except as specified herein. The system must be a one-way, multi-channel voice notification system incorporating user selectability of a minimum eight distinct sounds for tone signaling, and the incorporation of a voice module for delivery of recorded messages. Audible appliances must produce a three-pulse temporal pattern for two cycles followed by a voice message that is repeated until the control unit is reset or silenced. For carbon monoxide detector activation, audible appliances must produce a 520 Hz four-pulse temporal pattern for two cycles followed by a voice message that is repeated until the control unit is reset or silenced. Automatic messages must be broadcast through selected speakers throughout the building/facility. Provide the exterior speakers on a de-selectable separate zone so, if desired, the automatic messages can be broadcast over the interior speakers only. A live voice message must override the automatic audible output through use of a microphone input at the control unit or the LOC.

- a. When using the microphone, live messages must be broadcast throughout the facility. The system must be capable of operating all selected speakers at the same time. Provide the exterior speakers on a

de-selectable separate zone so, if desired, the live messages can be broadcast over the interior speakers only. The microphone must be hand-held style. Hand-held microphones must be housed in a separate protective cabinet. The cabinet must be accessible without the use of a key. The location of the microphone(s) must be approved by the Designated Fire Protection Engineer (DFPE).

- b. The microprocessor must actively interrogate circuitry, field wiring, and digital coding necessary for the immediate and accurate rebroadcasting of the stored voice data into the appropriate amplifier input. Loss of operating power, supervisory power, or any other malfunction that could render the digitalized voice module inoperative must automatically cause the three-pulse temporal pattern to take over all functions assigned to the failed unit in the event an alarm is activated.

2.3.4.1 Outputs and Operational Modules

All outputs and operational modules must be fully supervised with on-board diagnostics and trouble reporting circuits. Provide form "C" contacts for system alarm and trouble conditions. Provide circuits for operation of auxiliary appliance during trouble conditions. During a Mass Notification event, the control unit must not generate nor cause any trouble alarms to be generated with the Fire Alarm system.

2.3.4.2 Mass Notification

- a. The system must have the capability of utilizing an LOC with redundant controls of the FACU/ACU. Notification Appliance Circuits (NAC) must be provided for the activation of strobe appliances. Audio output must be selectable for line level. A hand-held microphone must be provided and, upon activation, must take priority over any tone signal, recorded message operation in progress, while maintaining the strobe NAC circuit activation.
- b. The Mass Notification functions must override the manual or automatic fire alarm notification. Other fire alarm functions including transmission of a signal(s) to the fire department must remain operational. When a mass notification announcement is disengaged and a fire alarm condition still exists, the audible and visual notification appliances must resume activation for alarm conditions. The fire alarm message must be of lower priority than all other messages (except any "test" messages") and must not override any other messages. When a pre-recorded mass notification announcement is disengaged, due to a microphone announcement, the pre-recorded message must resume after the mass notification microphone is released.
- c. Messages must be recorded professionally utilizing standard industry methods, in a professional female voice. Message and tone volumes must both be at the same decibel level. Messages recorded from the system microphone must not be accepted. A 520 Hz tone (as required by NFPA 72) must precede messages and be similar to the following unless Installation or Facility specific messages are required:
 - (1) Carbon Monoxide: "May I have your attention please. May I have your attention please. Carbon monoxide has been detected in the building. Please walk to the nearest exit and leave the building." (Provide a 2 second pause.) "May I have your attention please, (repeat the tones and message on a continuous

loop)."

- (2) Fire: "May I have your attention please. May I have your attention please. A fire emergency has been reported in the building. Please leave the building by the nearest exit or exit stairway. Do not use the elevators." (Provide a 2 second pause.) "May I have your attention please, (repeat the tones and message on a continuous loop)."

- d. Auxiliary Input Module must be designed to be an outboard expansion module to either expand the number of optional LOC's, or allow a telephone interface.

2.3.4.3 Installation-Wide Control

An installation-wide control system for mass notification exists on the Base, the autonomous control unit must communicate with the central control unit of the Installation-wide system. The autonomous control unit must receive commands/messages from the central control unit and provide status information.

2.3.5 Memory

Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors, or other age-dependent devices must not be considered as equal to non-volatile processors, PROMS, or EPROMS.

2.3.6 Field Programmability

Provide control units and control units that are fully field programmable for both input and output of control, initiation, notification, supervisory, and trouble functions. The system program configuration must be menu driven. System changes must be password protected. Any proprietary equipment and proprietary software needed by qualified technicians to implement future changes to the fire alarm system must be provided as part of this contract.

2.3.7 Input/Output Modifications

The FACU/ACU must contain features that allow the bypassing of input devices from the system or the modification of system outputs. These control features must consist of a control unit mounted keypad. Any bypass or modification to the system must indicate a trouble condition on the FACU/ACU.

2.3.8 Resetting

Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory or trouble condition on the system still exists.

2.3.9 Walk Test

The FACU/ACU must have a walk test feature. When using this feature, operation of initiating devices must result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated in the history log, but no other outputs occur.

2.3.10 History Logging

The control unit must have the ability to store a minimum of 400 events in a log. These events must be stored in a battery-protected memory and must remain in the memory until the memory is downloaded or cleared manually. Resetting of the control unit must not clear the memory.

2.3.11 Manual Access

An operator at the control unit, having a proper access level, must have the capability to manually access the following information for each initiating device.

- a. Primary status.
- b. Device type.
- c. Present average value.
- d. Present sensitivity selected.
- e. Detector range (normal, dirty).

2.4 LOCAL OPERATING CONSOLES (LOC)

2.4.1 General

The LOC must consist of a remote microphone station incorporating a push-to-talk (PTT) hand-held microphone and system status indicators. The LOC must have the capability of being utilized to activate prerecorded messages. The unit must incorporate microphone override of any tone generation or recorded messages. The unit must be fully supervised from the FACU/ACU. The housing for the LOC must not be lockable.

2.5 AMPLIFIERS

Any amplifiers, and other hardware necessary for a complete, operational, textual audible circuit conforming to NFPA 72 must be housed in a remote amplifier cabinet, or in the FACU/ACU. Individual amplifiers must be 100 watts maximum.

2.5.1 Operation

The system must automatically operate and control all building speakers.

2.5.2 Construction

Amplifiers must utilize computer grade solid state components and must be provided with output protection devices sufficient to protect the amplifier against any transient up to 10 times the highest rated voltage in the system.

2.5.3 Tone Generator

The tone generator must be integral to the FACU/ACU. Tones must be stored digitally along with the voice messages.

2.5.4 Protection Circuits

Each amplifier must be constantly supervised for any condition that could render the amplifier inoperable at its maximum output. Failure of any component must cause a trouble signal.

2.6 REMOTE ANNUNCIATOR

2.6.1 LCD Annunciator

Provide a flush mounted annunciator that includes an LCD display. The display must indicate the device in trouble/alarm or any supervisory device. Display the device name, address. The remote annunciator must duplicate functions of the FACU/ACU for message display, fire alarm, supervisory alarm, and trouble conditions, visual and audible notification, and system reset functions. Remote annunciator must require the use of a key for accessing the reset, control and other functions.

A building floor plan must be provided and mounted (behind Plexiglass or similar protective material) at the annunciator location. The floor plan must indicate all rooms by name and number including the locations of stairs and elevators. The floor plan must show all devices and their programmed address to facilitate identification of their physical location from the LCD display information.

2.7 MANUAL STATIONS

Provide metal or plastic, semi-flush mounted, double-action, addressable manual stations, that are not subject to operation by jarring or vibration. Stations must be equipped with screw terminals for each conductor. Stations that require the replacement of any portion of the device after activation are not permitted. Stations must be finished in red with molded raised lettering operating instructions of contrasting color. The use of a key must be required to reset the station.

2.8 SMOKE DETECTORS

2.8.1 Spot Type Detectors

Provide addressable photoelectric smoke detectors as follows:

- a. Provide analog/addressable photoelectric smoke detectors utilizing the photoelectric light scattering principle for operation in accordance with UL 268. Smoke detectors must be listed for use with the FACU/ACU.
- b. Provide self-restoring type detectors that do not require any readjustment after actuation at the FACU/ACU to restore them to normal operation. The detector must have a visual indicator to show actuation.
- c. Vibration must have no effect on the detector's operation. Protect the detection chamber with a fine mesh metallic screen that prevents the entrance of insects or airborne materials. The screen must not inhibit the movement of smoke particles into the chamber.
- d. Provide twist lock bases with screw terminals for each conductor. The detectors must maintain contact with their bases without the use of springs.

- e. The detector address must identify the particular unit, its location within the system, and its sensitivity setting. Detectors must be of the low voltage type rated for use on a 24 VDC system.

2.8.2 Duct Smoke Detectors

Duct-mounted addressable photoelectric smoke detectors must consist of a smoke detector, as specified in paragraph Spot Type Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry must be mounted in a metallic or plastic enclosure exterior to the duct. It is not permitted to cut the duct insulation to install the duct detector directly on the duct. Detectors must be listed for operation over the complete range of air velocities, temperature and humidity expected at the detector when the air-handling system is operating. Detectors must be powered from the FACU/ACU.

- a. Sampling tubes must run the full width of the duct. The duct detector package must conform to the requirements of NFPA 90A, UL 268A, and must be listed for use in air-handling systems. The control functions, operation, reset, and bypass must be controlled from the FACU/ACU.
- b. Lights to indicate the operation and alarm condition must be visible and accessible with the unit installed and the cover in place. Remote indicators must be provided where required by NFPA 72. Remote indicators as well as the affected fan units must be properly identified in etched plastic placards.
- c. Detectors must provide for control of auxiliary contacts that provide control, interlock, and shutdown functions. Auxiliary contacts provide for this function must be located within 3 feet of the controlled circuit or appliance. The auxiliary contacts must be supplied by the fire alarm system manufacturer to ensure complete system compatibility.
- d. A trouble condition must report to the FACU/ACU when the duct smoke detector cover is removed.

2.9 AIR SAMPLING SMOKE DETECTION SYSTEM

The air sampling smoke system must consist of a detector assembly housing an integral aspiration fan, filter, laser-based detection chamber and control, output and supervision circuitry. The system must consist of a piping or tubing distribution network that runs from the detector assembly(s) to the protected area(s) and is supported by air sampling smoke detection system calculations from a computer-based design modeling tool. The system must include configurable alarm and trouble relay outputs for interface to other systems where required.

- a. System must be complete in all ways. It must include all engineering, and electrical installation, all detection and control equipment, auxiliary devices and controls, alarm interface, functional checkout and testing, training and all other operations necessary for a functional system.
- b. Program alarm thresholds to the following values unless the results of the pre-Government system tests indicate a clear need to change them. In the event that such a need is indicated, notify the Contracting Officer and provide complete documentation concerning the need to

deviate from these values. Include within the deviation documentation request, information that complies with the paragraph entitled "Sensitivity Verification Test". Ensure initial threshold levels are approved prior to the Government test.

(1) Alarm Level 1: set ALERT at 0.2 percent obscuration/foot

(2) Alarm Level 2: set FIRE 1 at 1.0 percent obscuration/foot

c. All air sampling smoke detection devices and associated components must be new, standard products or the manufacturer's latest design and suitable to perform the functions intended.

d. The laser detection chamber must be of the mass light scattering type and capable of detecting a wide range of smoke particle types of varying size. A particle counting method must be employed for the purposes of:

(1) Preventing large particles from affecting the true smoke reading.

(2) Monitoring contamination of the filter (for example, dust and dirt) to automatically notify when maintenance is required. The particle counting method must not be used for the purpose of smoke density measurement.

e. Detector(s) must be self-monitoring for filter contamination and provide indication through system fault when replacement is necessary. Detectors which allow automatic reset of filter status upon removal and re-insertion are not permitted.

f. Detector(s) must contain relays for alarm and fault conditions. The relays must be software programmable to the required functions.

g. Detector(s) must permit configuration by programmers that are either integral to the system, portable or PC based.

h. Detector(s) must allow programming of:

(1) Smoke threshold alarm levels; ALERT, PRE-ALARM, FIRE 1 and FIRE 2.

(2) Time delays. Ensure the display control unit contains individual adjustable alarm time delay features for each of the alarm threshold levels. Provide an adjustment range between 0 and 60 seconds. Program the alarm threshold time delays to 30 seconds for alarm levels 1 and 2, and 15 seconds for alarm levels 3 and 4.

(3) Faults, including airflow, detector, power, filter and network, as well as an indication of the urgency of the fault.

(4) Configuration of relay outputs for remote indication of alarm and fault conditions.

(5) General purpose input functionality.

2.10 CARBON MONOXIDE DETECTOR

Analog/addressable carbon monoxide (CO) detectors must be listed to UL 2075 and set to respond to the sensitivity limits of UL 2034. Carbon monoxide detectors must be listed for use with fire alarm control units. Detectors

must be surface mounted in the horizontal orientation and supported independently of wiring connections. Detectors must be self-restoring. For FACU/ACU with no listed compatible addressable CO detectors, provide listed 4-wire detectors. Detector must be provided with an LED status indicator.

- a. Where 4-wire CO detectors are necessary, each 4-wire CO detector must be individually monitored via addressable interface modules for alarm and off normal/trouble conditions (including loss of power to the individual detector). Power circuits for 4-wire CO detectors must be dedicated to powering the CO detectors only. Battery powered and 120 VAC powered detectors are prohibited.
- b. Wiring connections must be made by means of screw terminals and detectors must be equipped with trouble relays. Detectors must be able to mount a single-gang electrical box.
- c. A trouble condition at an individual CO detector must not affect any other CO detectors. CO detectors must be powered by the FACU/ACU.
- d. Detectors must be provided with a means to test CO gas entry into the CO sensing cell.

2.11 ADDRESSABLE INTERFACE DEVICES

The initiating device being monitored must be configured as a Class "B" initiating device circuits. The module must be listed as compatible with the control unit. The module must provide address setting means compatible with the control unit's SLC supervision and store an internal identifying code. Monitor module must contain an integral LED that flashes each time the monitor module is polled and is visible through the device cover plate. Pull stations with a monitor module in a common backbox are not required to have an LED. Modules must be listed for the environmental conditions in which they will be installed.

2.12 ADDRESSABLE CONTROL MODULES

The control module must be capable of operating as a relay (dry contact form C) for interfacing the control unit with other systems, and to control auxiliary functions. The module must be listed as compatible with the control unit. The indicating device or the external load being controlled must be configured as Class B notification appliance circuits. The system must be capable of supervising, audible, visual and dry contact circuits. The control module must have both an input and output address. The supervision must detect a short on the supervised circuit and must prevent power from being applied to the circuit. The control module must provide address setting means compatible with the control unit's SLC supervision and store an internal identifying code. The control module must contain an integral LED that flashes each time the control module is polled and is visible through the device cover plate. Control Modules must be listed for the environmental conditions in which they will be installed.

2.13 ISOLATION MODULES

- a. Provide isolation modules to subdivide each signaling line circuit in accordance with NFPA 72 and UFC 3-600-01 between adjacent isolation modules.

- b. Isolation modules must provide short circuit isolation for signaling line circuit wiring.
- c. Power and communications must be supplied by the SLC and must report faults to the FACU/ACU.
- d. After the wiring fault is repaired, the fault isolation modules must test the lines and automatically restore the connection.

2.14 NOTIFICATION APPLIANCES

2.14.1 Audible Notification Appliances

Audible appliances must conform to the applicable requirements of UL 464. Appliances must be connected into notification appliance circuits or speaker circuits. Audible appliances in finished areas must be recessed and installed with a white grille. Audible appliances in areas exposed to structure must be surface-mounted and white in color.

2.14.1.1 Speakers

- a. Speakers must conform to the applicable requirements of UL 1480. Speakers must have a minimum of four different sound output levels and operate with audio line input levels of 70.7 VRMs and 25 VRMs, by means of selectable tap settings. Interior speaker tap settings must include taps of 1/4, 1/2, 1, and 2 watt, at a minimum. Exterior speakers must also be multi-tapped with no more than 15 watt maximum setting. Speakers must incorporate a high efficiency speaker for maximum output at minimum power across a frequency range of 400 Hz to 4,000 Hz, and must have a sealed back construction. Speakers must be capable of installation on standard 4-inch square electrical boxes. Where speakers and strobes are provided in the same location, they may be combined into a single unit. All inputs must be polarized for compatibility with standard reverse polarity supervision of circuit wiring via the FACU/ACU.
- b. Provide speaker mounting plates constructed of cold rolled steel having a minimum thickness of 16 gage or molded high impact plastic and equipped with mounting holes and other openings as needed for a complete installation. Fabrication marks and holes must be ground and finished to provide a smooth and neat appearance for each plate. Each plate must be primed and painted.
- c. Speakers must utilize screw terminals for termination of all field wiring.

2.14.2 Visual Notification Appliances

Visual notification appliances must conform to the applicable requirements of UL 1638, UL 1971 and conform to the Architectural Barriers Act (ABA). Visual Notification Appliances must have clear high intensity optic lens, xenon flash tubes, or light emitting diode (LED) and be marked "Alert" in letters of contrasting color. The light pattern must be dispersed so that it is visible above and below the strobe and from a 90 degree angle on both sides of the strobe. Strobe flash rate must be 1 flash per second and meet NFPA 72 requirements for candela based on the UL 1971 test. Strobe must be surface mounted.

2.14.3 Textual Display Signs

Textual display signs must be two text line static LED with a height necessary to meet the requirements of NFPA 72. The text display must spell out the word "EVACUATE" or "ANNOUNCEMENT". The design of text display must be such that it cannot be read when not illuminated.

LED text displays must meet the following requirements at a minimum:

- a. Two lines of information for high priority messaging.
- b. Text must be no less than height requirements and color/contrast requirements of NFPA 72.
- c. Displays must be wall or ceiling mounted.
- d. Mounting brackets for a convenient wall/cubicle mount.
- e. The system must interface with the textual display sign control panel to activate the proper message.
- f. Displays must be powered by the FACU/ACU.

2.15 ELECTRIC POWER

2.15.1 Primary Power

Power must be 120 VAC service for the fire alarm system from the AC service to the building in accordance with NFPA 72.

2.16 SECONDARY POWER SUPPLY

Provide battery backup for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power must be automatic and must not cause transmission of a false alarm.

2.16.1 Batteries

Provide maintenance-free, sealed lead acid batteries as the source for emergency power. Batteries must contain suspended electrolyte. The battery system must be maintained in a fully charged condition by means of a solid state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.

2.16.1.1 Capacity

Battery size must be the greater of the following two capacities. This capacity applies to every control unit associated with this system, including supplemental notification appliance circuit panels, auxiliary power supply panels, fire alarm transmitters, and Base-wide mass notification transceivers. When determining the required capacity under alarm condition, visual notification appliances must include both textual and non-textual type appliances.

- a. Sufficient capacity to operate the fire alarm system under supervisory and trouble conditions, including audible trouble signal devices for 48 hours and audible and visual signal devices under alarm conditions

for an additional 15 minutes.

- b. Sufficient capacity to operate the mass notification for 60 minutes after loss of AC power.

2.16.1.2 Battery Power Calculations

- a. Verify that battery capacity exceeds supervisory and alarm power requirements for the criteria noted in the paragraph "Capacity" above.
 - (1) Substantiate the battery calculations for alarm and supervisory power requirements. Include ampere-hour requirements for each system component and each control unit component, and compliance with UL 864.
 - (2) Provide complete battery calculations for both the alarm and supervisory power requirements. Submit ampere-hour requirements for each system component with the calculations.
 - (3) Provide voltage drop calculations to indicate that sufficient voltage is available for proper operation of the system and all components. Calculations must be performed using the minimum rated voltage of each component.
- b. For battery calculations assume a starting voltage of 24 VDC for starting the calculations to size the batteries. Calculate the required Amp-Hours for the specified standby time, and then calculate the required Amp-Hours for the specified alarm time. Using 20.4 VDC as starting voltage, perform a voltage drop calculation for circuits containing device and/or appliances remote from the power sources.

2.16.2 Battery Chargers

Provide a solid state, fully automatic, variable charging rate battery charger. The charger must be capable of providing 120 percent of the connected system load and must maintain the batteries at full charge. In the event the batteries are fully discharged (20.4 Volts dc), the charger must recharge the batteries back to 95 percent of full charge within 48 hours after a single discharge cycle as described in paragraph CAPACITY above. Provide pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided.

2.17 SURGE PROTECTIVE DEVICES

Surge protective devices must be provided to suppress all voltage transients which might damage fire alarm control unit components. Systems having circuits located outdoors, communications equipment must be protected against surges induced on any signaling line circuit. Cables and conductors, that serve as communications links, must have surge protection circuits installed at each end. The surge protective device must wire in series to the power supply of the protected equipment with screw terminations. Line voltage surge arrestor must be installed directly adjacent to the power panel where the FACU/ACU breaker is located.

- a. Surge protective devices for nominal 120 VAC must be UL 1449 listed with a maximum 500 volt suppression level and have a maximum response time of 5 nanoseconds. The surge protective device must also meet IEEE C62.41.1 and IEEE C62.41.2 category B tests for surge capacity.

The surge protective device must feature multi-stage construction and be provided with a long-life indicator lamp (either light emitting diode or neon) which extinguishes upon failure of protected components. Any unit fusing must be externally accessible.

- b. Surge protective devices for nominal 24 VAC, fire alarm telephone dialer, or ethernet connection must be UL 497B listed, meet IEEE C62.41.1 and have a maximum response time of 1-nanosecond. The surge protective device must feature multi-stage construction and be self-resetting. The surge protective device must be a base and plug style. The base assembly must have screw terminals for fire alarm wiring. The base assembly must accept "plug-in" surge protective module.
- c. All surge protective devices (SPD) must be the standard product of a single manufacturer and be equal or better than the following:
 - (1) For 120 VAC nominal line voltage: UL 1449 and UL 1283 listed, series connected 120 VAC, 20A rated, surge protective device in a NEMA 4x enclosure. Minimum 50,000 amp surge current rating with EMI/RFI filtering and a dry contact circuit for remote monitoring of surge protection status.
 - (2) For 24-volt nominal line voltage: UL 497B listed, series connected low voltage, 24-volt, 5A rated, loop circuit protector, base and replaceable module.
 - (3) For alarm telephone dialers: UL 497A listed, series connected, 130-volt, 150 mA rated with self-resetting fuse, dialer circuit protector with modular plug and play.
 - (4) For IP-DACTS: UL 497B listed, series connected, 6.4-volt, 1.5A rated with 20 kA/pair surge current, data network protector with modular plug and play.

2.18 WIRING

Provide wiring materials under this section as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM with the additions and modifications specified herein.

2.18.1 Alarm Wiring

IDC and SLC wiring must be solid copper cable in accordance with the manufacturers requirements. Copper signaling line circuits and initiating device circuit field wiring must be minimum size as indicated on the contract drawings. Visual notification appliance circuit conductors, that contain audible alarm appliances, must be copper with minimum size as indicated on the contract drawings. Speaker circuits must be copper with minimum size as indicated on the contract drawings and be twisted and shielded conductors at a minimum. Wiring for textual notification appliance circuits must be in accordance with manufacturer's requirements but must be supervised by the FACU/ACU. Wire size must be sufficient to prevent voltage drop problems. Circuits operating at 24 VDC must not operate at less than the listed voltages for the detectors and/or appliances. Power wiring, operating at 120 VAC minimum, must be a minimum No. 12 AWG solid copper having similar insulation. Acceptable power-limited cables are FPL, FPLR or FPLP as appropriate with colored covering based on type of circuit. Nonpower-limited cables must comply

with NFPA 70. Wire color coding must follow Rhode Island state color coding requirements.

2.19 INTERFACE TO THE BASE-WIDE MASS NOTIFICATION NETWORK

2.19.1 Radio

The mass notification transceiver must be bi-direction, have the ability to interface with the base-wide Federal Signal system, and meet all the requirements of paragraph, RADIO TRANSMITTER AND INTERFACE PANELS as specified in this Specification Section. The transceiver utilized in the mass notification system must be capable of the following:

- a. Communication with the central control/monitoring system to provide supervision of communication link and status changes are reported by automatic and manual poll/reply/acknowledge routines.
- b. All monitored points/status changes are transmitted immediately and at programmed intervals until acknowledged by the central control/monitoring system.
- c. Each transceiver must transmits a unique identity code as part of all messages; the code is set by the user at the transceiver.

2.20 AUTOMATIC FIRE ALARM TRANSMITTERS

2.20.1 Radio Transmitter and Interface Panels

Transmitters must be compatible with proprietary supervising station receiving equipment. Each radio alarm transmitter must be the manufacturer's recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Transmitters must be provided in accordance with applicable portions of NFPA 72, Federal Communications Commission (FCC) 47 CFR 90 and Federal Communications Commission (FCC) 47 CFR 15. Transmitter electronics module must be contained within the physical housing as an integral, removable assembly. The proprietary supervising station receiving equipment is Digitize 3505 and the transmitter must be fully compatible with this equipment. At the contractors option, and if listed, the transmitter may be housed in the same control unit as the FACU/ACU. The transmitter must be narrowband radio, with FCC certification for narrowband operation and meets the requirements of the NTIA (National Telecommunications and Information Administration) Manual of Regulations and Procedures for Federal Frequency Management.

2.20.1.1 Operation

Operate each transmitter from 120-volt ac power. In the event of 120-volt ac power loss, the transmitter must automatically switch to battery operation. Switchover must be accomplished with no interruption of protective service, and must automatically transmit a trouble message. Upon restoration of ac power, transfer back to normal ac power supply must also be automatic.

2.20.1.2 Battery Power

Transmitter standby battery capacity must provide sufficient power to operate the transmitter in a normal standby status for a minimum of 72 hours and be capable of transmitting alarms during that period.

2.20.1.3 Transmitter Housing

Use NEMA Type 1 for housing. The housing must contain a lock that is keyed identical to the fire alarm system for the building. Radio alarm transmitter housing must be factory painted with a suitable priming coat and not less than two coats of a hard, durable weatherproof enamel.

2.20.1.4 Antenna

Antenna must be omnidirectional, coaxial, halfwave dipole antennas for radio alarm transmitters with a driving point impedance to match transmitter output. The antenna and antenna mounts must be corrosion resistant and designed to withstand wind velocities of 100 mph. Do not mount antennas to any portion of the building roofing system. Protect the antenna from physical damage.

2.20.2 Signals to Be Transmitted to the Base Receiving Station

Refer to the contract drawings for the signals to be sent to the base receiving station.

2.21 SYSTEM MONITORING

2.21.1 Valves

Each valve affecting the proper operation of a fire protection system, including automatic sprinkler control valves, sprinkler service entrance valve, valves at fire pumps, isolating valves for pressure type waterflow or supervision switches, and valves at backflow preventers, whether supplied under this contract or existing, must be electrically monitored to ensure its proper position. Provide each tamper switch with a separate address.

2.22 ENVIRONMENTAL ENCLOSURES OR GUARDS

Environmental enclosures must be provided to permit fire alarm/mass notification components to be used in areas that exceed the environmental limits of the listing. The enclosure must be listed for the device or appliance as either a manufactured part number or as a listed compatible accessory for the component is currently listed. Guards required to deter mechanical damage must be either a listed manufactured part or a listed accessory for the category of the initiating device or notification appliance.

PART 3 EXECUTION

3.1 VERIFYING ACTUAL FIELD CONDITIONS

Before commencing work, examine all adjoining work on which the contractor's work is in any way dependent for perfect workmanship according to the intent of this specification section, and report to the Contracting Officer's Representative any condition which prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.

3.2 INSTALLATION

3.2.1 Fire Alarm and Mass Notification Control Unit (FACU/ACU)

Locate the FACU/ACU where indicated on the drawings. Surface mount the enclosure. Conductor terminations must be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection must be permanently mounted in the FACU/ACU. Locate the document storage cabinet adjacent to the FACU/ACU unless the Contracting Officer directs otherwise.

3.2.2 Battery Cabinets

When batteries will not fit in the FACU/ACU, locate battery cabinets below or adjacent to the FACU/ACU. Battery cabinets must be installed at an accessible location when standing at floor level. Battery cabinets must not be installed lower than 12 inches above finished floor, measured to the bottom of the cabinet, nor higher than 36 inches above the floor, measured to the top of the cabinet. Installing batteries above drop ceilings or in inaccessible locations is prohibited. Battery cabinets must be large enough to accommodate batteries and also to allow ample gutter space for interconnection of control units as well as field wiring. The cabinet must be provided in a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions. The cabinet must be identified by an engraved phenolic resin nameplate. Lettering on the nameplate must indicate the control unit(s) the batteries power and must not be less than 1-inch high.

3.2.3 Manual Stations

Locate manual stations as indicated on the contract drawings.

3.2.4 Notification Appliances

- a. Locate notification appliance devices as required by NFPA 72 where indicated and to meet the intelligibility requirements. Where two or more visual notification appliances are located in the same room or corridor or field of view, provide synchronized operation. Devices must use screw terminals for all field wiring. Audible and visual notification appliances mounted in acoustical ceiling tiles must be centered in the tiles plus or minus 2 inches.
- b. Audible and visual notification appliances mounted on the exterior of the building, within unconditioned spaces, or in the vicinity of showers must be listed weatherproof appliances installed on weatherproof backboxes.
- c. Speakers must not be located in close proximity to the FACU/ACU or LOC so as to cause feedback when the microphone is in use. Shunt speakers in the Lobby/vestibule area and Fire pump room when mics are in use to avoid feedback since microphones are located in these areas.

3.2.5 Smoke and Heat Detectors

Locate detectors as required by NFPA 72 and their listing as indicated on the contract drawings on a 4-inch mounting box. Detectors installed in acoustical ceiling tiles must be centered in the tiles plus or minus 2 inches.

3.2.6 Carbon Monoxide Detectors

Locate detectors as required by NFPA 72 and their listings as indicated on the contract drawings on a 4-inch mounting box.

3.2.7 Air Sampling Smoke Detector

Locate air sampling smoke detectors in accordance with the manufacturer's instructions. Air sampling smoke detectors must be installed as follows:

a. Air Sampling Smoke Detector Assembly:

- (1) Detector assembly must be mounted to a wall at a height as indicated on the contract drawings.
- (2) Mounting must be in a fully accessible and visible location.
- (3) Mounting or attachment to site equipment, cable trays, movable walls, other equipment or equipment supports is not permitted.
- (4) Piping network insertion into the detector inlet must not be glued.
- (5) Air sampling smoke detector assembly must be installed in accordance with this specification section and the manufacturer's installation and instruction manuals.
- (6) Flexible tubing for termination of the sampling pipe network into detector inlet is not permitted unless allowed by its listing.
- (7) Provide red background with white lettering labels that are plastic or phenolic type with a minimum of 0.25-inch block lettering to indicate detector and zone. For example: "AIR SAMPLING SMOKE DETECTOR No. 1-1 No. 5".
- (8) Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the ASD panel. The card must show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions must be approved by the Contracting Officer before being posted.

b. Pipe and Sampling Tube Mounting:

- (1) The pipe and sampling tubing detection network must be mounted as per the design and manufacturer's specification. The hardware used for mounting will depend upon the design and site requirements.
- (2) To minimize flexing, pipes must be secured every 5 feet.
- (3) Pipes must be suspended between 1 and 4 inches below the ceiling. In areas with a suspended ceiling, the pipe network must be installed above the ceiling utilizing the manufacturer's capillary sample port supported by the ceiling.
- (4) The sampling tubes must be of the same length or use the manufacturer's guidelines to run tubes of the required lengths.

- (5) When installing a pipe network in areas subject to high temperature fluctuations allow for the contraction and expansion of pipes.
- (6) Where expansion or contraction of pipes is likely either after installation or on a continuous basis, do not place pipe clips adjacent to couplings and socket unions as these may interfere with the movement of the pipe.
- (7) No bends are permitted within the first 18 inches from the detector inlet.
- (8) The routing of the piping and sample tube network must be coordinated with potential obstructions, including cable trays, grounding bars, and HVAC ductwork.
- (9) All changes in direction must be made with standard elbows or tees.
- (10) All joints must be air-tight and made by using solvent cement, except at the entry to the detector assembly. Refer to ASTM F402.
- (11) All pipes must be supported by mechanical hangers attached to the structure of the building. Not more than 1-foot of pipe must extend beyond the last hanger of each sampling pipe. The final installation must result in no noticeable deflection in the piping network.
- (12) Attachment of air sampling pipes to cable trays, "gray iron", and telecommunications equipment is prohibited.
- (13) Clearly label pipe network to distinguish the pipe from other facility pipe work or protective cabling enclosures. For example: "SMOKE DETECTION SAMPLING TUBE - DO NOT DISTURB". In open rooms and exposed areas, provide labels at no greater than 20-foot intervals. Provide labels every 10 feet where piping is installed above suspended ceilings and every 2 feet, centered in the floor panels, where piping is installed within the raised floor cavity.
- (14) Placement of the sampling tube must take into consideration appropriate sampling point locations and spacing.

c. Air Sampling Points:

- (1) Open area ceiling sampling points must be oriented downward and must be within 1 to 4 inches below the underside of the ceiling above where the ceiling is smooth.
- (2) Label all air sampling points with a round red label, each with a center hole to match the diameter of the drilled sampling point. For example: "AIR SAMPLING POINT DIA 0.125 INCHES". Indicate fractional dimensions in decimal format with a minimum of three decimal places.

3.2.8 LCD REMOTE Annunciator

Locate the LCD annunciator as shown on the contract drawings. Recess the panel in finished spaces.

3.2.9 Local Operating Console (LOC)

Locate the LOC(s) as indicated on the contract drawings.

3.2.10 Ceiling Bridges

Provide ceiling bridges for ceiling-mounted appliances. Ceiling bridges must be as recommended/required by the manufacturer of the ceiling-mounted notification appliance.

3.3 SYSTEM FIELD WIRING

3.3.1 Wiring within Cabinets, Enclosures, and Boxes

Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Conductors must be connected to screw-type terminal blocks and must not be spliced. Mark each terminal in accordance with the wiring diagrams of the system. The use of wire nuts or similar devices is prohibited. Wiring to conform with NFPA 70.

Indicate the following in the wiring diagrams:

- a. Point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between the equipment or systems that are supervised or controlled by the system. Diagrams must show connections from field devices to the FACU/ACU and remote fire alarm/mass notification control units, initiating circuits, switches, relays and terminals.
- b. Complete riser diagrams indicating the wiring sequence of devices and their connections to the control equipment. Include a color code schedule for the wiring. Include floor plans showing the locations of devices and equipment.

3.3.2 Alarm Wiring

- a. Voltages must not be mixed in any junction box, housing or device, except those containing power supplies and control relays.
- b. Utilize shielded wiring where recommended by the manufacturer. For shielded wiring, ground the shield at only one point, in or adjacent to the FACU/ACU.
- c. Pigtail or T-tap connections to signal line circuits, initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited.
- d. Color coding is required for circuits and must be maintained throughout the circuit. Conductors used for the same functions must be similarly color coded. Conform wiring to NFPA 70. Wire color coding must follow Rhode Island State color coding requirements.
- e. Pull all conductors splice free. The use of wire nuts, crimped connectors, or twisting of conductors is prohibited. Where splices are unavoidable, the location of the junction box or pull box where they occur must be identified on the as-built drawings. The number and location of splices must be subject to approval by the Designated

Fire Protection Engineer (DFPE).

3.3.3 Back Boxes and Conduit

In addition to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, provide all wiring in rigid metal conduit or intermediate metal conduit unless specifically indicated otherwise. Minimum conduit size must be 3/4-inch in diameter. Do not use electrical non-metallic tubing (ENT) or flexible non-metallic tubing and associated fittings.

- a. Galvanized rigid steel (GRS) conduit must be utilized where exposed to weather, where subject to physical damage, and where exposed on exterior of buildings. Intermediate metal conduit (IMC) may be used in lieu of GRS as allowed by NFPA 70.
- b. Electrical metallic tubing (EMT) is permitted above suspended ceilings or exposed where not subject to physical damage. Do not use EMT underground, encased in concrete, mortar, or grout, in hazardous locations, where exposed to physical damage, outdoors or in fire pump rooms. Use die-cast compression connectors.
- c. For rigid metallic conduit (RMC), only threaded type fitting are permitted for wet or damp locations.
- d. Flexible metal conduit is permitted for initiating device circuits 6 feet in length or less. Flexible metal conduit is permitted for notification appliance circuits 6 feet in length or less in areas with acoustical ceiling tiles. Flexible metal conduit is prohibited for signaling line circuits. Use liquid tight flexible metal conduit in damp and wet locations.
- e. Schedule 40 (minimum) polyvinyl chloride (PVC) is permitted where conduit is routed underground or underground below floor slabs. Convert non-metallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before turning up through floor slab.
- f. Exterior wall penetrations must be weathertight. Conduit must be sealed to prevent the infiltration of moisture.

3.3.4 Conductor Terminations

Labeling of conductors at terminal blocks in FACU/ACU, and remote FACU/ACU and the LOC must be provided at each conductor connection. Each conductor or cable must have a shrink-wrap label to provide a unique and specific designation. Each FACU/ACU and remote FACU/ACU must contain a laminated drawing that indicates each conductor, its label, circuit, and terminal. The laminated drawing must be neat, using 12 point lettering minimum size, and mounted within each cabinet, control unit, or unit so that it does not interfere with the wiring or terminals.

3.4 FIRESTOPPING

Provide firestopping for holes at conduit penetrations through, fire-rated walls, fire barriers, and fire partitions in accordance with Section 07 84 00 FIRESTOPPING.

3.5 PAINTING

- a. In unfinished areas (including areas above drop ceilings), factory paint all electrical conduit (serving fire alarm equipment), fire alarm conduit, surface metal raceway, junction boxes and covers red.
- b. Exposed conduit will not be permitted in finished areas unless approved by the DFPE and Architect. In finished areas, paint exposed electrical conduit (serving fire alarm equipment), fire alarm conduit, surface metal raceways, junction boxes, and electrical boxes to match adjacent finishes. The inside cover of the junction box must be identified as "Fire Alarm".
- c. Field painting must comply with Section 09 90 00 PAINTS AND COATINGS.

3.6 FIELD QUALITY CONTROL

3.6.1 Test Procedures

Submit detailed test procedures, prepared and signed by the Fire Alarm System Designer, and the representative of the installing company, and reviewed by the QFPE 60 days prior to performing system tests. Detailed test procedures must list all components of the installed system such as initiating devices and circuits, notification appliances and circuits, signaling line devices and circuits, control devices/equipment, batteries, transmitting and receiving equipment, power sources/supply, annunciators, interface equipment, and surge protective devices. Test procedures must include sequence of testing, time estimate for each test, and sample test data forms. The test data forms must be in a check-off format (pass/fail with space to add applicable test data; similar to the forms in NFPA 72 and NFPA 4.) The test procedures and accompanying test data forms must be used for the pre-Government testing and the Government testing. The test data forms must record the test results and must:

- a. Identify the NFPA Class of all Initiating Device Circuits (IDC), and Notification Appliance Circuits (NAC), Voice Notification System Circuits (NAC Audio), and Signaling Line Circuits (SLC).
- b. Identify each test required by NFPA 72 Test Methods and required test herein to be performed on each component, and describe how these tests must be performed.
- c. Identify each component and circuit as to type, location within the facility, and unique identity within the installed system. Provide necessary floor plan sheets showing each component location, test location, and alphanumeric identity.
- d. Identify all test equipment and personnel required to perform each test, including equipment necessary for smoke detector testing. The use of magnets is not permitted.
- e. Provide space to identify the date and time of each test. Provide space to identify the names and signatures of the individuals conducting and witnessing each test.

3.6.2 Pre-Government Testing

3.6.2.1 Verification of Compliant Installation

Conduct inspections and tests to ensure that devices and circuits are functioning properly. Tests must meet the requirements of paragraph entitled "Minimum System Tests" as required by NFPA 72. The contractor and an authorized representative from each supplier of equipment must be in attendance at the pre-Government testing to make necessary adjustments. After inspection and testing is complete, provide a signed Verification of Compliant Installation letter by the QFPE that the installation is complete, compliant with the specification and fully operable. The letter must include the names and titles of the witnesses to the pre-Government tests. Provide all completion documentation as required by NFPA 72 including all referenced annex sections and the test reports noted below.

- a. NFPA 72 Record of Completion.
- b. NFPA 72 Record of Inspection and Testing.
- c. Fire Alarm and Emergency Communication System Inspection and Testing Form.
- d. Audibility test results with marked-up test floor plans.
- e. Intelligibility test results with marked-up floor plans.
- f. Documentation that all tests identified in the paragraph "Minimum System Tests" are complete.

3.6.2.2 Request for Government Final Test

When the verification of compliant installation has been completed, submit a formal request for Government final test to the Designated Fire Protection Engineer (DFPE). Government final testing will not be scheduled until the DFPE has received copies of the request for Government final testing and Verification of Compliant Installation letter with all required reports. Government final testing will not be performed until after the connections to the installation-wide fire reporting system and the installation-wide mass notification system have been completed and tested to confirm communications are fully functional. Submit request for test at least 15 calendar days prior to the requested test date.

3.6.3 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests must be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.6.4 Government Final Tests

The tests must be performed in accordance with the approved test procedures in the presence of the DFPE. Furnish instruments and personnel required for the tests. The following must be provided at the job site for Government Final Testing:

- a. The manufacturer's technical representative.

- b. The contractor's Qualified Fire Protection Engineer (QFPE).
- c. Marked-up red line drawings of the system as actually installed.
- d. Loop resistance test results.
- e. Complete program printout including input/output addresses.
- f. Copy of pre-Government Test Certificate, test procedures and completed test data forms.
- g. Audibility test results with marked-up floor plans.
- h. Intelligibility test results with marked-up floor plans.

Government Final Tests will be witnessed by the Designated Fire Protection Engineer and Qualified Fire Protection Engineer (QFPE). At this time, any and all required tests noted in the paragraph "Minimum System Tests" must be repeated at their discretion.

3.7 MINIMUM SYSTEM TESTS

3.7.1 System Tests

Test the system in accordance with the procedures outlined in NFPA 72. The required tests are as follows:

- a. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests must be witnessed by the Contracting Officer and test results recorded for use at the final Government test.
- b. Verify the absence of unwanted voltages between circuit conductors and ground. The tests must be accomplished at the pre-Government test with results available at the final system test.
- c. Verify that the fire alarm equipment is in the normal condition as detailed in the manufacturer's O&M manual.
- d. Test each initiating device and notification appliance and circuit for proper operation and response at the control unit. Smoke detectors must be tested in accordance with manufacturer's recommended calibrated test method. Use of magnets is prohibited. Testing of duct smoke detectors must comply with the requirements of NFPA 72 except disconnect at least 20 percent of devices. If there is a failure at these devices, then supervision must be tested at each device.
- e. Carbon Monoxide Detector Tests: Carbon monoxide detectors must be tested in accordance with NFPA 72 and the manufacturer's recommended calibrated test method.
- f. Test the system for specified functions in accordance with the contract drawings and specifications and the manufacturer's O&M manual.
- g. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the time period and in the manner specified.

- h. Determine that the system is operable under trouble conditions as specified.
- i. Visually inspect wiring.
- j. Test the battery charger and batteries.
- k. Verify that software control and data files have been entered or programmed into the FACU/ACU. Hard copy records of the software must be provided to the Contracting Officer.
- l. Verify that red-line drawings are accurate.
- m. Measure the current in circuits to ensure there is the calculated spare capacity for the circuits.
- n. Measure voltage readings for circuits to ensure that voltage drop is not excessive.
- o. Disconnect the verification feature for smoke detectors during tests to minimize the amount of smoke needed to activate the sensor. Testing of smoke detectors must be conducted using canned smoke.
- p. Measure the voltage drop at the most remote appliance (based on wire length) on each notification appliance circuit.
- q. Verify the documentation cabinet is installed and contains all as-built shop drawings, product data sheets, design calculations, site-specific software data package, and all documentation required by paragraph titled "Test Reports".

3.7.2 Audibility Tests

Sound pressure levels from audible notification appliances must be a minimum of 15 dBA over ambient with a maximum of 110 dBA in any occupiable area. The provisions for audible notification (audibility and intelligibility) must be met with doors, fire shutters, movable partitions, and similar devices closed.

3.7.3 Intelligibility Tests

Intelligibility testing of the System must be accomplished in accordance with NFPA 72 for Voice Evacuation Systems, and ASA S3.2. Following are the specific requirements for intelligibility tests:

- a. Intelligibility Requirements: Verify intelligibility by measurement after installation.
- b. Ensure that a CIS value greater than the required minimum value provided in each area where building occupants typically could be found. The minimum required value for CIS is 0.7. Rounding of values is permitted.
- c. Areas of the building provided with hard wall and ceiling surfaces (such as metal or concrete) that are found to cause excessive sound reflections may be permitted to have a CIS score less than the minimum required value if approved by the DFPE, and if building occupants in these areas can determine that a voice signal is being broadcast and

they must walk no more than 33 feet to find a location with at least the minimum required CIS value within the same area.

- d. Areas of the building where occupants are not expected to be normally present are permitted to have a CIS score less than the minimum required value if personnel can determine that a voice signal is being broadcast and they must walk no more than 50 feet to a location with at least the minimum required CIS value within the same area.
- e. Take measurements near the head level applicable for most personnel in the space under normal conditions (e.g., standing, sitting, sleeping, as appropriate).
- f. The distance the occupant must walk to the location meeting the minimum required CIS value must be measured on the floor or other walking surface as follows:
 - (1) Along the centerline of the natural path of travel, starting from any point subject to occupancy with less than the minimum required CIS value.
 - (2) Curving around any corners or obstructions, with a 12 inches clearance there from.
 - (3) Terminating directly below the location where the minimum required CIS value has been obtained.

Use commercially available test instrumentation to measure intelligibility as specified by NFPA 72 as applicable. Use the mean value of at least three readings to compute the intelligibility score at each test location.

3.8 SYSTEM ACCEPTANCE

Following acceptance of the system, as-built drawings and O&M manuals must be delivered to the Contracting Officer for review and acceptance. The drawings must show the system as installed, including deviations from both the contract drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final Government test of the system. At least one set of as-built (marked-up) drawings must be provided at the time of, or prior to the Final Government Test.

- a. The drawings must be prepared electronically and sized no less than the contract drawings. Furnish one set of CDs or DVDs containing software back-up and CAD based drawings in latest version of AutoCAD, and portable document formats (pdf) of as-built drawings and schematics.
- b. Include complete wiring diagrams showing connections between devices and equipment, both factory and field wired.
- c. Include a riser diagram and drawings showing the as-built location of devices and equipment.
- d. Provide Operation and Maintenance (O&M) Instructions.

3.9 INSTRUCTION OF GOVERNMENT EMPLOYEES

3.9.1 Instructor

Provide the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the operation, inspection, testing, and maintenance of the system provided. The instructor must train the Government employees designated by the Contracting Officer, in the care, adjustment, maintenance, and operation of the fire alarm and mass notification system. The instructor must be thoroughly familiar with all parts of this installation. The instructor must be trained in operating theory as well as in practical O&M work. Submit the instructors information and qualifications including the training history.

3.9.2 Required Instruction Time

Provide 8 hours of instruction after final acceptance of the system. The instruction must be given during regular working hours on such dates and times selected by the Contracting Officer. The instruction may be divided into two or more periods at the discretion of the Contracting Officer. The training must allow for rescheduling for unforeseen maintenance and/or fire department responses.

3.9.3 Technical Training Manual

Provide, in manual format, lesson plans, operating instructions, maintenance procedures, and training data for the training courses. The operations training must familiarize designated government personnel with proper operation of the installed system. The maintenance training course must provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

3.10 EXTRA MATERIALS

3.10.1 Repair Service/Replacement Parts

Repair services and replacement parts for the system must be available for a period of 10 years after the date of final acceptance of this work by the Contracting Officer. During the warranty period, the service technician must be on-site within 24 hours after notification. All repairs must be completed within 24 hours of arrival on-site.

During the warranty period, the installing fire alarm contractor is responsible for conducting all required testing and maintenance in accordance with the requirements and recommended practices of NFPA 72 and the system manufacturers. Installing fire alarm contractor is NOT responsible for any damage resulting from abuse, misuse, or neglect of equipment by the end user.

3.10.2 Spare Parts

Spare parts furnished must be directly interchangeable with the corresponding components of the installed systems. Spare parts must be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts must be delivered to the Contracting Officer at the time of the Government testing and must be accompanied by an inventory list.

3.10.3 Document Storage Cabinet

Upon completion of the project, but prior to project close-out, place in the document storage cabinet copies of the following record documentation:

- a. As-built shop drawings
- b. Product data sheets
- c. Design calculations
- d. Site-specific software data package
- e. All documentation required by SD-06.

-- End of Section --

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SECTION 31 11 00

CLEARING AND GRUBBING
11/18

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

SD-03 Product Data

Tree Wound Paint

SD-07 Certificates

SD-11 Closeout Submittals

1.2 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Tree Wound Paint

Use bituminous based paint from standard manufacture specially formulated for tree wounds.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.1.2 Trees, Shrubs, and Existing Facilities

Protect trees and vegetation to be left standing from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor is responsible for the repair of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify the Contracting Officer in ample time to minimize interruption of the service. Refer to Section 01 30 00 ADMINISTRATIVE REQUIREMENTS and Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS for additional utility protection.

3.2 Application

3.3 CLEARING

Clearing consists of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing also includes the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Cut off flush with or below the original ground surface trees, stumps, roots, brush, and other vegetation in areas to be cleared, except such trees and vegetation as may be indicated or directed to be left standing. Trim dead branches 1-1/2 inches or more in diameter on trees designated to be left standing within the cleared areas and trim all branches to the heights indicated or directed. Neatly cut close to the bole of the tree or main branches, limbs and branches to be trimmed. Paint, with an approved tree-wound paint, cuts more than 1-1/2 inches in diameter.

3.3.1 Tree Removal

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work includes the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Dispose of trees as specified in paragraph DISPOSAL OF MATERIALS.

3.3.2 Pruning

Trim trees designated to be left standing within the cleared areas of dead branches 1-1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1-1/4 inches in diameter with an approved tree wound paint.

3.3.3 Grubbing

Grubbing consists of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Remove material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Fill depressions made by grubbing with suitable material and compact to make the surface conform with the original

adjacent surface of the ground.

3.4 DISPOSAL OF MATERIALS

Dispose of excess materials in accordance with the approved solid waste management permit and include those materials in the solid waste management report.

All wood or wood like materials, except for salable timber, remaining from clearing, pruning or grubbing such as limbs, tree tops, roots, stumps, logs, rotten wood, and other similiar materials shall become the property of the Contractor and disposed of as specified. All non-saleable timber and wood or wood like materials remaining from timber harvesting such as limbs, tree tops, roots, stumps, logs, rotten wood, and other similiar materials shall become the property of the Contractor and disposed as specified.

3.4.1 Saleable Timber

All timber removed from the project site shall become the property of the Contractor.

-- End of Section --

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SECTION 31 21 13

VAPOR MITIGATION

11/18

PART 1 GENERAL

1.1 SUMMARY

Provide all work necessary to reduce and maintain radon concentration levels below 4.0 picoCuries per liter (pCi/L) in various buildings specified herein. Perform mitigation system installation, and perform post-mitigation testing and monitoring for vapor.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 210 (2016) Laboratory Methods of Testing Fans
for Aerodynamic Performance Rating

AMERICAN ASSOCIATION OF RADON SCIENTISTS AND TECHNOLOGISTS (AARST)

ANSI/AARST MALB (2014) Protocol for Conducting
Measurements of Radon and Radon Decay
Products in Schools and Large Buildings

ANSI/AARST RMS-LB (2018) Radon Mitigation Standards for
Schools and Large Buildings

ASTM INTERNATIONAL (ASTM)

ASTM C920 (2018) Standard Specification for
Elastomeric Joint Sealants

ASTM D2665 (2014) Standard Specification for
Poly(Vinyl Chloride) (PVC) Plastic Drain,
Waste, and Vent Pipe and Fittings

ASTM D2729 (2017) Standard Specification for
Poly(Vinyl Chloride) (PVC) Sewer Pipe and
Fittings

ASTM E2121 (2013) Standard Practice for Installing
Radon Mitigation Systems in Existing
Low-Rise Residential Buildings

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-7 (2014) Compressed Air for Human
Respiration; 6th Edition

INTERNATIONAL CODE COUNCIL (ICC)

ICC IMC (2021) International Mechanical Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA 1378 (1995) Thermoplastic Duct (PVC)
Construction Manual, 2nd Edition

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 402-R-92-003 (1993) Protocols for Radon and Radon Decay
Product Measurements in Homes

EPA 402-R-92-004 (1992) Indoor Radon and Radon Decay
Product Measurement Device Protocols

EPA 402-R-92-014 (1993) Radon Measurement in Schools

EPA 402-R-93-078 (1993; R 1994) Radon Mitigation Standards

EPA 625-R-92-016 (1993; Am 1994) Radon Prevention in Design
and Construction of Schools and Other
Large Buildings

EPA 625-R-93-011 (1993) Radon Reduction Technique for
Existing Detached Houses: Technical
Guidance for Active Soil Depressurization
Systems

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1096 (2017) Ionizing Radiation

29 CFR 1926.59 Hazard Communication

29 CFR 1926.103 Respiratory Protection

42 CFR 84 Approval of Respiratory Protective Devices

1.3 DEFINITIONS

1.3.1 Active Soil Depressurization (ASD)

A family of radon mitigation systems involving mechanically-driven soil depressurization, including sub-slab depressurization (SSD), sub-membrane depressurization (SMD), block wall depressurization (BWD) and crawl space depressurization (CSD).

1.3.2 Contract Documents

Documents furnished to prospective bidders/proposers containing information and specifying criteria and project requirements for diagnostic testing, design, construction and monitoring of multiple radon mitigation systems. The documents include this specification and the drawings listed in and accompanying this specification.

1.3.3 Long Term Vapor Detectors

Alpha track, electret ion chamber, or approved equivalent. Devices capable of sensing and recording the presences of radon during a time period of 91 days to 12 months which when analyzed provide a numeric value, measured in pCi/L, for vapor concentrations during the time exposed.

1.3.4 Pressure Differential Gauge

A tool used to measure the PFE created by an ASD system. Calibrate the gauge in accordance with national standards and the manufacturer's recommendations. The gauge must be capable of readings to 1/1000 in water column

1.3.5 Pressure Field Extension (PFE)

The distance that a pressure change, created by drawing soil-gas through a suction point, extends outward in a sub-slab gas permeable layer, under a membrane, behind a solid wall or in a hollow wall.

1.3.6 Qualified Mitigation Professional

Regardless of team composition, a "Qualified Mitigation Professional" for the purposes of this document is defined as: "An individual that has demonstrated a minimum degree of appropriate technical knowledge and skills specific to radon mitigation of schools and large buildings: a) as established in certification requirements of the National Radon Proficiency Program (NRPP) or the National Radon Safety Board (NRSB); and b) as required by statute, state licensure or certification program, where applicable."

1.4 SYSTEM DESCRIPTION AND REQUIREMENTS

1.4.1 Performance Requirements

Radon mitigation systems must reduce and maintain radon concentration levels below 4.0 pCi/L in various buildings specified herein. Test and construct radon mitigation systems in accordance with ANSI/AARST RMS-LB, ANSI/AARST MALB, ASTM E2121 EPA 402-R-93-078, EPA 402-R-92-003, EPA 402-R-92-004 and as specified herein. Additional guidance for testing and constructing vapor mitigation systems is contained in EPA 625-R-92-016 and EPA 625-R-93-011.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" or classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Respirators; G

Vapor Mitigation Systems Components

SD-06 Test Reports

Post Mitigation Testing; G

SD-07 Certificates

Worker Protection Plan; G

Medical Certification; G

Worker Notification; G

Respiratory Protection Program; G

Contractor Qualifications; G

Contractor Experience; G

Testing Laboratory Certification; G

Proof Of Current Calibration For Testing Devices; G

Vapor Mitigation System Inspection; G

SD-08 Manufacturer's Instructions

Vapor Mitigation Systems Components

SD-10 Operation and Maintenance Data

Vapor Mitigation Systems, Data Package 2; G

Submit in accordance with Section 01 78 23 OPERATION AND
MAINTENANCE DATA.

SD-11 Closeout Submittals

Radon Detector Location Log; G

Respirator Program Records; G

1.6 VAPOR DETECTOR LOCATION LOG

Prepare and provide to the Contracting Officer a Vapor Detector Location Log for each building detailing the identity and location of each short term and long term vapor detector. Prepare the log using copies of the "Device Placement Log" contained in EPA 402-R-92-014, and provide the appropriate information as line items. In addition to the log, on a copy of the building floor plans, locate and identify each short term and long term detector.

1.7 WORKER HEALTH AND SAFETY

Comply with OSHA, state and local standards or regulations relating to worker safety and occupational radon exposure. Prepare a worker protection plan in accordance with 29 CFR 1910.1096, and EPA 402-R-93-078.

1.7.1 Worker Protection Plan

The worker protection plan must address, at a minimum occupational radon exposure, safe use of all job site equipment including safe practices when using ladders or scaffolding; safe procedures for crawl space work and avoidance of job site hazards; discussion of hantavirus symptoms; fire and life safety issues; confined space access; handling caustic solvents and bonding chemicals; appropriate use of personal protective equipment; respiratory protection program; suspected contaminants such as asbestos, lead paint, mold or other toxins that may exist; safety data sheets (SDS); ventilated work areas as required to reduce occupational radon exposure. Adhere to 29 CFR 1926.59 and provide the Contracting Officer with a copy of the SDS for all materials brought to the site.

1.7.2 Worker Exposure Records

Maintain records of worker exposure to radon sufficient to verify that workers are exposed to less than four working level months (WLM) in any 12-month period.

1.7.3 Medical Certification

Provide a written certification for each worker and supervisor, signed by a licensed physician indicating that the worker and supervisor has met or exceeded all of the medical prerequisites listed herein and in 29 CFR 1910.1096 and 29 CFR 1926.103 as prescribed by law. Submit certificates prior to the start of work.

1.7.4 Worker Notification

Train workers exposed to radon about the hazards of exposure to radon and the need to apply protective measures when working in areas with elevated radon concentrations. Training must comply with 29 CFR 1910.1096. Submit a notification signed by each worker acknowledging they have been properly trained regarding the hazards of vapor exposure.

1.8 RESPIRATORY PROTECTION PROGRAM

Establish and implement a respirator program as required by 29 CFR 1910.1096, and 29 CFR 1926.103. Submit a written description of the program to the Contracting Officer. Submit a written program manual or operating procedure including methods of compliance with regulatory statutes.

1.8.1 Respirator Program Records

Submit records of the respirator program as required by 29 CFR 1926.103, and 29 CFR 1910.1096.

1.8.2 Respirator Fit Testing

Conduct a qualitative or quantitative fit test conforming to 29 CFR 1926.103 for each worker required to wear a respirator, and any

authorized visitors who enter a regulated area where respirators are required to be worn. A respirator fit test must be performed prior to initially wearing a respirator and every 12 months thereafter. If physical changes develop that will affect the fit, a new fit test must be performed. Functional fit checks must be performed each time a respirator is put on and in accordance with the manufacturer's recommendation.

1.8.3 Respirator Selection and Use Requirements

Provide respirators, and ensure that they are used as required by 29 CFR 1910.1096, 29 CFR 1926.103 and in accordance with CGA G-7 and the manufacturer's recommendations. Respirators must be approved by the National Institute for Occupational Safety and Health NIOSH, under the provisions of 42 CFR 84, for use in environments containing radon. For air-purifying respirators, the particulate filter must be high-efficiency particulate air (HEPA)/(N-,R-,P-100). The initial respirator selection and the decisions regarding the upgrading or downgrading of respirator type must be made by the Contractor's Designated IH based on the measured or anticipated airborne radon concentrations to be encountered.

1.8.3.1 Respirators

Provide personnel with respiratory protection as indicated in 29 CFR 1926.103. Breathing air must comply with CGA G-7.

1.9 QUALITY ASSURANCE

1.9.1 Contractor Qualifications and Experience

Within 15 days after award, submit written evidence or data demonstrating that the Contractor and one or more subcontractors employed by the Contractor possess the qualifications and experience specified below.

1.9.1.1 Contractor Qualifications

The person responsible for diagnostic testing, construction and on-site supervision, as required by the specifications, must have successfully completed the requirements of and maintaining a current certification issued by either the National Radon Proficiency Program (NRPP) or the National Radon Safety Board (NRSB) as a qualified mitigation professional. Alternatively, in a State with legislation requiring mandatory credentialing for this work, compliance with the State legislation is acceptable. Evidence showing successful completion of the requirements of the NRPP or the NRSB must include copy of current certification document and documentation issued by the State.

1.9.1.2 Contractor Experience

Submit written evidence demonstrating that the Contractor has successfully designed and installed at least two radon or vapor mitigation systems of the same or similar to the type required herein. The Contractor must have 3 years of experience installing radon or vapor mitigation systems. Experience proof must include but not be limited to:

- a. The contract name and number, completion dates of the project and the total cost of the project;
- b. The names, telephone numbers and fax number of the facility or installation for whom the radon mitigation system design, construction

and testing were performed;

- c. The name, telephone number and fax number of a supervisory level point of contact at each facility or installation who has knowledge of the Contractor's performance.

1.9.1.3 Qualified Mitigation Professional

A Qualified Mitigation Professional must be physically present or ensure a responsible person is present during onsite activities and immediately available to direct, instruct and oversee activities of other individuals, mitigation installers and other professionals engaged in installation activities for the mitigation system(s). The qualified mitigation professional must have 3 years of experience installing radon or vapor mitigation systems.

1.9.2 Testing Laboratory

Submit testing laboratory certification as proof that the testing laboratory performing radon detector analysis has successfully completed the requirements of the National Radon Safety Board (NRSB) or the National Radon Proficiency Program, (NRPP) and is qualified and authorized to perform such analysis. Alternatively, in a State with legislation requiring mandatory credentialing for this work, compliance with the State legislation is acceptable.

1.9.3 Diagnostic Testing Equipment

Submit proof of current calibration for testing devices used in performing diagnostic testing.

1.9.4 On-Site Supervision

No work at the site will be permitted without the presence of a person possessing the qualifications specified elsewhere in this section, namely certification issued by either the National Radon Proficiency Program, (NRPP) or the National Radon Safety Board (NRSB) as a qualified mitigation professional, or the State equivalent, where applicable.

1.9.5 Preconstruction Conference

Conduct a safety preconstruction conference to discuss the details of the Worker Protection Plan, Accident Prevention Plan (APP) including the AHAs required in specification section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS.

The safety preconstruction conference must include the Contractor and their Qualified Mitigation Professional, Designated IH and Project Supervisor and the Contracting Officer. Deficiencies in the APP will be discussed. Onsite work must not begin until the APP has been accepted.

1.10 DELIVERY, STORAGE AND HANDLING

1.10.1 Delivery of Products

Deliver materials to the site in an undamaged condition. Deliver proprietary items in manufacture's original unopened and undamaged containers or packages with manufacture's name and brand and other pertinent data such as specification number, type, and class, date of manufacture. Schedule deliveries of materials to coincide with scheduled installation.

1.10.2 Storage and Handling

Carefully store materials off the ground to provide proper ventilation, drainage and protection against weather and dampness. Protect materials from marring, staining, rust, damage and overload and from contaminants such as grease, oil and dirt. Store materials at temperatures recommended by the manufacturer. Handle material to avoid damage such as chipping and breaking. Replace damaged material.

PART 2 PRODUCTS

2.1 VAPOR MITIGATION SYSTEMS

2.1.1 System Performance

Vapor mitigation systems must reduce and maintain vapor concentration levels below 4.0 pCi/L after activation of the mitigation systems.

2.1.1.1 System Piping

Route vapor mitigation systems piping so as not to interfere with the daily operations and functions of the building occupants. Keep visibility of the systems to a minimum. Enclose each vapor mitigation system in occupied spaces, however, all operating components must be accessible for maintenance and repair. All spaces must be considered to be occupied spaces except for mechanical and electrical rooms, warehouses, storerooms, janitor closets, crawl spaces, and attic spaces.

2.1.1.2 System Outlet Location

Mitigation system discharge points must be as specified in ANSI/AARST RMS-LB and EPA 402-R-93-078. Prevent foreign objects from entering the outlet. Rain caps are not permitted. Maintain water tight seal through all penetrations to the building exterior.

2.1.1.3 System Failure Warning Monitor

Provide a means to detect and announce each vapor mitigation system failure. System failure is defined as:

- a. System blockage: foreign debris.
- b. Mechanical failure: fan or other mechanical failure.
- c. System leakage: pipe breakage or crack.

Provide an audio or visual annunciator device to indicate system failure and locate the annunciator device in an occupied space. Conform to the requirements of ANSI/AARST RMS-LB and EPA 402-R-93-078.

2.1.1.4 Air Cleaners

Do not use air cleaners as a vapor reduction method.

2.1.1.5 Ventilation Devices

Do not use devices that solely increase ventilation as a vapor reduction method.

2.1.1.6 Back Drafting

Do not allow vapor mitigation systems to cause back drafting of building chimneys.

2.1.2 Vapor Mitigation Systems Components

Mechanical and electrical materials, fabrication, construction and installation must conform to the following industry standards:

- a. Poly(vinyl chloride) (PVC) Piping- above slab: ASTM D2665, Schedule 40.
- b. Poly(vinyl chloride) (PVC) Piping - Below Slab: ASTM D2729, Schedule 40.
- c. In-line Tubular Centrifugal Fans: AMCA 210 and UL listed.
- d. Electrical Work: NFPA 70, NEMA MG 1, ANSI/AARST RMS-LB and EPA 402-R-93-078, No. 12 AWG minimum wire size, solid copper installed in EMT or surface metal raceway.
- e. Mechanical Work: ICC IMC, SMACNA 1378, ANSI/AARST RMS-LB and EPA 402-R-93-078.
- f. Sealants: ASTM C920, polyurethane, Type S, Grade P for horizontal application, Grade NS for vertical application, Class 25, Use T.
- g. Crawl space soil-gas retarder membrane must be minimum 60 mils thick.

PART 3 EXECUTION

3.1 RADON MITIGATION SYSTEMS INSTALLATION

3.1.1 Furnishings

Furniture and equipment will be removed from the area of work by the Government before vapor mitigation work begins.

3.1.2 Installation

- a. Provide vapor mitigation systems as indicated in the approved design drawings, as specified in ANSI/AARST RMS-LB, EPA 402-R-93-078 and as required by the specifications and standards referenced herein for the respective materials using workmen skilled in the trades involved. Install piping plumb and parallel to existing walls, partitions and ceilings as appropriate, slope horizontal runs to drain, and secure in place in a rigid and substantial manner.
- b. Seal new and existing floor slab penetrations in accordance with EPA 402-R-93-078 and as specified herein. Prevent entry of soil gas into the building and exhausting of conditioned air via the vapor mitigation system. Seal cracks and openings around floor slab penetrations with polyurethane sealant. Provide backer rod or comparable filler material as required. Insure that all penetrations to the building exterior are weathertight.
- c. Lay work out in advance. Exercise care where cutting, channeling,

chasing or drilling floors, walls, partitions, ceilings or other surfaces as necessary for proper installation, support or anchorage. Patch and repair damage to buildings, piping and equipment using workmen skilled in the trades involved.

d. Coordinate all work with the Contracting Officer.

3.1.3 Supervision

Installation of the radon mitigation systems must be supervised by a qualified mitigation professional.

3.1.4 Electrical Work

NFPA 70, ANSI/AARST RMS-LB and EPA 402-R-93-078, No. 12 AWG minimum wire size, solid copper installed in EMT or surface metal raceway. A source of electric power should be available within 50 feet of each fan installation.

3.1.5 Mechanical Work

ICC IMC, SMACNA 1378, ANSI/AARST RMS-LB, and EPA 402-R-93-078.

3.1.6 System Identification

Label all components of the radon mitigation systems including, but not limited to, piping (every 10 feet), enclosures, fans, electrical conduit (every 10 feet) and circuit breakers. Labels must read:

Vapor Reduction System. Do Not Turn Off.
Public Works Office Phone

or as specified by the Contracting Officer.

3.2 POST MITIGATION FUNCTIONAL EVALUATION/INSPECTION

3.2.1 ASD Systems

In conjunction with activating an ASD system, the suction in system piping must be measured and recorded along with at least one PFE measurement that is conducted under closed-building or normal operating conditions. It is recommended that both measurements be made under conditions that reflect normal building operation when significantly occupied and include consideration for worst-case conditions.

3.2.1.1 PFE Measurement

Obtain PFE measurements at more than one point distant from each suction point(s) to verify intended design using a differential pressure gauge capable of reading to 1/1000 in water column. Record PFE test location and close in a nonpermanent fashion to facilitate any future needs (e.g. diagnosing a system when radon tests do not indicate success in achieving mitigation goals).

3.2.2 Non-ASD Systems

Measurements of airflow volume, pressure and other system parameters that are applicable to the method chosen must be recorded after installation.

3.3 FIELD QUALITY CONTROL

3.3.1 Vapor Mitigation System Inspection

Inspect and approve in writing by a qualified mitigation professional each vapor mitigation system. Verify compliance with the design, ANSI/AARST MALB, ANSI/AARST RMS-LB and the presence of fire stops. Provide the Radon Mitigation System inspection to the Contracting Officer. Deficiencies identified in the inspection report must be corrected by the Contractor at no additional cost to the Government.

3.3.2 Post Mitigation Testing and Monitoring

Perform post mitigation vapor testing in the buildings as specified in ANSI/AARST RMS-LB, EPA 402-R-93-078 and herein.

3.3.2.1 Short Term

Test each vapor mitigation system as described below.

- a. Test each vapor mitigation system for effectiveness no sooner than 24-hours nor later than 15 days after activation of the vapor mitigation system. Perform all testing in accordance with ANSI/AARST MALB, ANSI/AARST RMS-LB and all local, state and Federal requirements. Provide short term vapor detectors (charcoal, electret ion chamber or approved equivalent) at the rate of one detector per 2,000 square feet but not less than one detector per enclosed space, except for closets. On copies of the building floor plans, locate and identify each short term detector and provide short term detector data on copies of the "Device Placement Log" contained in EPA 402-R-92-014.
- b. At the end of the testing period, collect the detectors and send the detectors to the testing laboratory for analysis. Provide vapor test results of the effectiveness of the mitigation systems not later than 30 days after collecting the detectors. Vapor test results must be sent from the testing laboratory directly to the Contracting Officer with one copy to the Contractor. Complete the line item information on the "Device Placement Log."
- c. Radon test results above 4.0 pCi/L require system redesign and installation modifications as necessary to achieve radon test results below 4.0 pCi/L. Submit design modifications to the Government for review and approval. After approval of the design modifications, provide installation modifications to the vapor mitigation system and retest for effectiveness. Repeat this short term test procedure until test results below 4.0 pCi/L are achieved.
- d. System modifications (as-built systems installations) must be reflected in the Contractor's design documents (drawings and design narrative).

3.3.2.2 Long Term

After acceptance of the vapor mitigation systems, provide for long term testing (8 to 12 months), see below.

- a. Perform all testing in accordance with ANSI/AARST MALB, ANSI/AARST RMS-LB and all local, state and Federal requirements. Provide long term vapor detectors (alpha track, electret ion chamber

or approved equivalent) at the rate of one detector per 2,000 square feet but not less than one detector per enclosed space, except for closets. Locate and identify each detector on copies of the building floor plans and in the Vapor Detector Location Log. After installing the detectors, furnish the completed detector documentation and mailers to the Contracting Officer.

- b. At the end of the testing period, the Contracting Officer will collect and send the detectors to the testing laboratory for analysis. Vapor test results must be sent from the testing laboratory directly to the Contracting Officer with one copy to the Contractor.
- c. Vapor test results above 4.0 pCi/L require system redesign and installation modifications as necessary to achieve radon test results below 4.0 pCi/L. Submit design modifications to the Government for review and approval. After approval of the design modifications, provide installation modifications to the vapor mitigation system and retest for effectiveness. Repeat the short term and long term test procedures specified herein until test results below 4.0 pCi/L are achieved.
- d. Payment for work required because long term testing results in readings above 4.0 pCi/L will be made from the funds identified in the "Schedule of Prices" for the work required under this paragraph and defined under the paragraph POST MITIGATION TESTING - SCHEDULE OF PRICES DATA included herein. Payment of these funds will be made only after the Contracting Officer has received the radon testing results from the testing laboratory and the readings for the long term testing are below 4.0 pCi/L.
- e. Final system modifications (as-built systems installations) must be reflected in the Contractor's design documents (drawings and design narrative).

-- End of Section --

SECTION 31 23 00.00 20

EXCAVATION AND FILL

02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600 (2017) Installation of Ductile-Iron Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C33/C33M (2018) Standard Specification for Concrete Aggregates

ASTM C136/C136M (2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM D698 (2012; E 2014; E 2015) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

ASTM D1140 (2017) Standard Test Methods for Determining the Amount of Material Finer than 75- μ m (No. 200) Sieve in Soils by Washing

ASTM D1556/D1556M (2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method

ASTM D1557 (2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)

ASTM D2487 (2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D3786/D3786M (2018) Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method

ASTM D4318 (2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4355/D4355M	(2014) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D4491/D4491M	(2017) Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533/D4533M	(2015) Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4632/D4632M	(2015a) Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	(2020) Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D4759	(2011; R 2018) Standard Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4833/D4833M	(2007; R 2020) Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual
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RHODE ISLAND DEPARTMENT OF TRANSPORTATION

RI DOT	Standard Specifications for Road and Bridge Construction Amended March 2018
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1.2 DEFINITIONS

1.2.1 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below a slab.

1.2.2 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557, for general soil types, abbreviated as percent laboratory maximum density.

1.2.3 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually

require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.4 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.5 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring and Sheeting Plan

Dewatering work plan

Submit 15 days prior to starting work.

SD-06 Test Reports

Borrow Site Testing; G

Fill and backfill test

Select material test

Porous fill test for capillary water barrier

Density tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations are as indicated.
- b. Pipes or other artificial obstructions, except those indicated, will not be encountered.
- c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.
- d. Material character is indicated by the boring logs.
- e. Borrow material, Suitable backfill and bedding material in the quantities required is not available at the project site.
- f. Blasting will not be permitted. Remove material in an approved manner.

1.6 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for all substances listed in Table 1, Table 2 and total petroleum hydrocarbons (TPH) as described in the Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases. Soils shall contain less than the residential direct exposure criteria for all substances in Table 1, less than the GA limit specified in Table 2, and less than 500 PPM TPH. Provide borrow site testing from a composite sample or material from the borrow site, with at least one test from each borrow site and at least one test per 500 tons of material to be imported. Material shall not be brought onsite until tests have been approved by the Contracting Officer.

1.7 QUALITY ASSURANCE

1.7.1 Shoring and Sheet Piling Plan

Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheet piling of excavations. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations shall include data and references used.

1.7.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work in accordance with Section 01 57 19 and Section 02 61 13.

1.7.3 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work

affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials

Any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, CH free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 6 inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.1.4 Backfill and Fill Material

ASTM D2487, classification GW, GP, GM, SW, SP, SM with a maximum ASTM D4318 liquid limit of 35, maximum ASTM D4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D1140, No. 200 sieve.

2.1.5 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C33/C33M fine aggregate grading with a maximum of 3 percent by weight passing ASTM D1140, No. 200 sieve, 1-1/2 inches and no more than 2 percent by weight passing the No. 4 size sieve and conforming to the general soil material requirements specified in paragraph entitled "Satisfactory Materials."

2.3 UTILITY BEDDING MATERIAL

Except as specified otherwise in the individual piping section, provide

bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe.

2.3.1 Sand

Clean, coarse-grained sand classified as Bedding Material in accordance with Section M.01.04 of the RI DOT Standard Specifications.

2.3.2 Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified as Bedding Material in accordance with Section M.01.04 of the RI DOT Standard Specifications.

2.4 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property. This material shall be in accordance with Section M.01.01 of the RI DOT Standard Specifications.

2.5 FILTER FABRIC

Provide a pervious sheet of polyester, nylon, glass or polypropylene, ultraviolet resistant filaments woven, spun bonded, fused, or otherwise manufactured into a nonraveling fabric with uniform thickness and strength. Fabric shall have the following manufacturer certified minimum average roll properties as determined by ASTM D4759:

	<u>Class A</u>	<u>Class B</u>
a. Grab tensile strength (ASTM D4632/D4632M) machine and transversed direction	min. 180	80 lbs.
b. Grab elongation (ASTM D4632/D4632M) machine and transverse direction	min. 15	15 percent
c. Puncture resistance (ASTM D4833/D4833M)	min. 80	25 lbs.
d. Mullen burst strength (ASTM D3786/D3786M)	min. 290	130 psi
e. Trapezoidal Tear (ASTM D4533/D4533M)	min. 50	25 lbs.
f. Apparent Opening Size (ASTM D4751)	See Criteria Below	
(1) Soil with 50 percent or less particles by weight passing US No. 200 Sieve, AOS less than 0.6 mm (greater than #30 US Std. Sieve)		

	<u>Class A</u>	<u>Class B</u>
(2) Soil with more than 50 percent particles by weight passing US No. 200 Sieve, AOS less than 0.297 mm (greater than #50 US Std. Sieve)		
g. Permeability (ASTM D4491/D4491M)	k fabric greater than k Soil	
h. Ultraviolet Degradation (ASTM D4355/D4355M)	70 percent Strength retained at 150 hours	

2.6 AGGREGATE AND GRAVEL BASE AND SUBBASE COURSES

Graded aggregate and gravel borrow courses conforming to RI DOT Standard Specifications for construction indicated.

2.6.1 Gravel Borrow

Consisting of bank run sand and gravel, or plant processed, crushed or uncrushed gravel with fine aggregate added as filler. Material shall conform to RI DOT Standard Specification, M.01.02 and M.01.09, Table I, Column I.

2.6.2 Crushed Stone

Coarse aggregate consisting of crushed bedrock, shall not contain crushed or uncrushed gravel and shall be free of deleterious material or soft, friable particles. Material shall conform to RI DOT Standard Specifications, M.01.09, Table I, Column II.

2.6.3 Filter Stone

Filter Stone for underdrains shall conform to the gradation requirements of Colum V, Table I, Subsection M.01.09 of the RI DOT Standard Specifications. Soundness shall conform to the requirements of Subsection M.01.11.

2.6.4 Crushed Stone for Underground Retention System

¾" to 2" clean, crushed, angular stone. Stone shall be double washed to remove all fines.

2.7 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes	
Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Potable Water Systems
Green:	Sewer Systems

2.7.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.7.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.8 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Provide shoring bracing, trench boxes and sheeting where required. In addition to Section 25 A and B of EM 385-1-1 and other requirements set forth in this contract, include provisions in the shoring and sheeting plan that will accomplish the following:

- a. Prevent undermining of pavements, foundations and slabs.
- b. Prevent slippage or movement in banks or slopes adjacent to the excavation.
- c. Allow for the abandonment of shoring and sheeting materials in place in critical areas as the work is completed. In these areas, backfill the excavation to the elevation indicated within 3 feet of the finished grade and remove the remaining exposed portion of the shoring before completing the backfill.

3.1.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils, prevent erosion and undermining of foundations. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 2 feet below the working level.

Operate dewatering system continuously until construction work below existing water levels is complete.

All dewatering shall be in accordance with Section 01 57 19 and Section 02 61 13.

3.1.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall contact the Public Works Department for assistance in locating existing utilities.

3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been

displaced or damaged.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations within the clearing limits. Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below existing surface.

3.2.2 Stripping

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be wasted. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

3.2.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with satisfactory material and compact to 95 percent of ASTM D1557 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with satisfactory material and compact to 95 percent of ASTM D1557 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.3.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Fill over excavations with concrete during foundation placement.

3.3.2 Pile Cap Excavation and Backfilling

Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer. Backfill and compact overexcavations and changes in grade due to pile driving operations to 95

percent of ASTM D698 maximum density.

3.3.3 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe.

3.3.4 Hard Material and Rock Excavation

Remove hard material and rock to elevations indicated in a manner that will leave foundation material in an unshattered and solid condition. Roughen level surfaces and cut sloped surfaces into benches for bond with concrete. Protect shale from conditions causing decomposition along joints or cleavage planes and other types of erosion. Removal of hard material and rock beyond lines and grades indicated will not be grounds for a claim for additional payment unless previously authorized by the Contracting Officer. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned by the Contractor and approved by the Contracting Officer. Common excavation shall consist of all excavation not classified as rock excavation.

3.3.5 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.3.6 Final Grade of Surfaces to Support Concrete

Excavation to final grade shall not be made until just before concrete is to be placed. For pile foundations, the excavation shall be stopped at an elevation 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, the remainder of the excavation shall be completed to the elevations shown. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.4 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or

natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified herein.

3.4.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade of the building with six passes of a 15 ton, pneumatic-tired roller. Operate the roller in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 miles per hour. When proof rolling under buildings, the building subgrade shall be considered to extend 5 feet beyond the building lines, and one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer. Rutting or pumping of material shall be undercut as directed by the Contracting Officer and replaced with select material.

3.5 SUBGRADE FILTER FABRIC

Place synthetic fiber filter fabric as indicated directly on prepared subgrade free of vegetation, stumps, rocks larger than 2 inches diameter and other debris which may puncture or otherwise damage the fabric. Repair damaged fabric by placing an additional layer of fabric to cover the damaged area a minimum of 3 feet overlap in all directions. Overlap fabric at joints a minimum of 3 feet. Obtain approval of filter fabric installation before placing fill or backfill. Place fill or backfill on fabric in the direction of overlaps and compact as specified herein. Follow manufacturer's recommended installation procedures.

3.6 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.6.1 Gravel Borrow and Crushed Stone Placement

Provide for under paved areas or concrete as shown on the plans. Use materials meeting RI DOT specifications. Place in 6 inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Do not place over wet or frozen areas. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.6.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6 inch lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or

against the structure.

3.6.3 Select Material Placement

Provide under structures not pile supported. Place in 6 inch lifts. Do not place over wet or frozen areas. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

3.6.4 Backfill and Fill Material Placement Over Pipes and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.6.5 Porous Fill Placement

Provide under floor and area-way slabs on a compacted subgrade. Place in 4 inch lifts with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.6.6 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one foot over pipe outside structures and paved areas.

3.7 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

3.8 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.9 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend

continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.10 COMPACTION

Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be reduced by 5 percent.

3.10.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the paved area or structure to 85 percent of ASTM D1557.

3.10.2 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D1557. Compact fill and backfill material to 95 percent of ASTM D1557.

3.10.3 Adjacent Area

Compact areas within 5 feet of structures to 90 percent of ASTM D1557.

3.10.4 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D1557. Compact fill and backfill materials to 95 percent of ASTM D1557.

3.11 SPECIAL EARTHWORK REQUIREMENTS FOR UNDERDRAINS

Excavate stormwater bioretention filter basins and associated underdrain area to dimensions indicated. Backfill underdrains around and over the pipes after pipe installation has been approved. Place crushed stone material in 6 inch lifts and compact with mechanical, vibrating plate tampers or rammers until no further consolidation can be achieved. Compact backfill overlying the crushed stone material as specified for adjacent or overlying work.

3.11.1 Crushed Stone Backfill Without Filter Fabric

3.11.1.1 Perforated or Slotted Wall Pipe

Place crushed stone material as pipe is laid and extend as dimensioned on the plans.

3.11.2 Crushed Stone Backfill Using Filter Fabric

3.11.2.1 Perforated Pipes at Stormwater Bioretention Filter Basin

Wrap one layer of filter fabric around crushed stone backfill in such a manner that fabric overlap is a minimum of 2 inches. Place Crushed stone

material under the bioretention filter basins, with perforated underdrain set where and as detailed on the plans.

3.12 FINISH OPERATIONS

3.12.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.12.2 Topsoil and Seed

Scarify existing subgrade. Provide 4 inches of topsoil for newly graded finish earth surfaces and areas disturbed by the Contractor. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading. If there is insufficient on-site topsoil meeting specified requirements for topsoil, provide topsoil required in excess of that available. Seeding shall be per Section 32 92 19.

Provide mulch and water to establish an acceptable stand of grass.

3.12.3 Protection of Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.13 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.14 FIELD QUALITY CONTROL

3.14.1 Sampling

Take the number and size of samples required to perform the following tests.

3.14.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.14.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C136/C136M for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.14.2.2 Select Material Testing

Test select material in accordance with ASTM C136/C136M for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200

sieve; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.14.2.3 Porous Fill Testing

Test porous fill in accordance with ASTM C136/C136M for conformance to gradation specified in ASTM C33/C33M.

3.14.2.4 Density Tests

Test density in accordance with ASTM D1556/D1556M, or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556/D1556M density test at a location already ASTM D6938 tested as specified herein. Perform an ASTM D1556/D1556M density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut. Include density test results in daily report.

Bedding and backfill in trenches: One test per 50 linear feet in each lift.

-- End of Section --

SECTION 31 41 16

METAL SHEET PILING
11/20

PART 1 GENERAL

1.1 DESCRIPTION

Furnish, install and test metal sheet piles at the locations indicated on the drawings (which are a portion of the Pipe-Z combinaiton bulkhead) and specified herein. King Pile test piles will be placed approx. every 100 lineal feet in locations that can be incorporated into the work in accordance with 31 62 16.13 STEEL PIPE PILES.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.5M/D1.5 (2020) Bridge Welding Code

ASTM INTERNATIONAL (ASTM)

ASTM A6/A6M (2021) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

ASTM A572/A572M (2021; E 2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

1.3 BASIS OF BID

For unit price bid, see PRICE SCHEDULE.

Requirements of FAR 52.211-18 "Variation in Estimated Quantity" shall not apply to payment for piling. Each pile and test pile acceptably provided will be paid for at the bid unit price per unit length, which price shall include items incidental to furnishing and driving the piles including: mobilization and demobilization, predrilling, probing, redriving uplifted piles, and cutting off piles at the cutoff elevation. Payment shall be made for production and test piles at the bid unit price for the length of pile, from tip to final cutoff, actually provided, including splices directed by the Contracting Officer to be made. Should the actual cumulative pile length driven (tip to cutoff) vary more than 25 percent from the total pile length specified as a basis for bidding, at the direction of the Contracting Officer, the unit price per unit length will be adjusted in accordance with provisions of FAR 52.236-2 "Differing Site Conditions."

1.3.1 Pulled Piles

Piles required to be pulled at no fault of the Contractor will be paid for

at the bid unit price for furnishing and driving the pile in its original position plus 25 percent of the amount to cover the cost of pulling. Such pulled piles when redriven will be paid for at 25 percent of the bid unit price for the length driven.

1.3.2 Pile Tests

Payment for each acceptably provided complete installation of a single indicator pile will be made at the contract unit price per test, which price shall include furnishing, placing, and removing indicator pile. At the direction of the Contracting Officer, pile tests (indicator piles) may be waived at a credit to the Government of the unit price bid therefore.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installation Procedures; G

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1.5 DELIVERY, STORAGE, AND HANDLING

Conform all delivery, storage, and handling of materials to the requirements specified herein. Develop and submit plans for the delivery, storage, and handling of piles. Submit delivery, storage, and handling plans for piles at least 30 days prior to delivery of piles to the job site.

1.5.1 Delivery and Storage

Materials delivered to the site must be new and undamaged and must be accompanied by certified test reports. Provide the manufacturer's logo and mill identification mark on the sheet piling as required by the referenced specifications. Store and handle sheet piling in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks; as a minimum, support on level blocks or racks spaced not more than 10 feet apart and not more than 2 feet from the ends. Storage of sheet piling should also facilitate required inspection activities and prevent damage to coatings and corrosion protection prior to installation.

1.5.2 Handling

Lift piles to ensure that the maximum permissible curvature is not exceeded. Holes may be burned above the cutoff length for lifting piles into the leads. If there is evidence of pile damage during driving due to the holes, Contracting Officer may forbid the burning of holes. Do not damage piles when dragging piles across the ground or barge deck.

Inspect piles for excessive curvature and for damage before transporting them from the storage area to the driving area and immediately prior to placement in the driving leads. Curvature in the pile must be measured with the pile laying on a flat surface and is the distance between the pile at the mid-length of the pile and the flat surface. Straightness of the sections of piles must conform to AWS D1.5M/D1.5, Section 3.5.1.1. Piles having excessive curvature will be rejected.

1.5.3 Damaged Piles

Inspect each pile for straightness and structural damage before transporting them to the project site and immediately prior to placement in the driving leads. Bring any damage to the attention of the Contracting Officer. Piles which are damaged during delivery, storage, or handling to the extent they are rendered unsuitable for the work, in the opinion of the Contracting Officer, will be rejected and removed from the project site, or may be repaired, if approved, at no cost to the Government.

Any pile damaged by reason of internal defects or by improper driving must

be corrected by one of the following methods approved by the Contracting Officer for the pile in question:

- a. The pile is withdrawn, if practicable, and replaced by a new and, if necessary, longer pile.
- b. One or more replacement piles are driven adjacent to the defective pile.

A pile driven below the specified butt elevation must be corrected by one of the following methods approved by the Contracting Officer:

- a. The pile is spliced (if approved).
- b. A sufficient portion of the pile cap is extended down to properly embed the pile (if approved).

A pile driven out of its proper location or out of plumb as approved by the Contracting Officer, must be corrected by one of the following methods approved by the Contracting Officer:

- a. One or more replacement piles are driven next to the pile in question.
- b. As directed by the Contracting Officer.

1.6 MATERIAL CERTIFICATES

For each shipment, submit certificates identified with specific lots prior to installing piling. Include in the identification data piling type, dimensions, chemical composition, mechanical properties, section properties, heat number, and mill identification mark.

PART 2 PRODUCTS

2.1 METAL PILING

Submit detail drawings for pipe (king) piling and sheet piling, including fabricated sections, showing complete piling dimensions and details, driving sequence and location of installed piling.

- a. Include in the drawings details of top protection, special reinforcing tips, tip protection (shoes), lagging, splices, fabricated additions to plain piles, cut-off method, corrosion protection, and dimensions of templates and other temporary guide structures for installing piling. Provide details of the method for handling piling to prevent permanent deflection, distortion or damage to piling interlocks.
- b. Metal sheet piling must be hot-rolled steel sections conforming to ASTM A572/A572M, Grade 50. Metal pipe (king) piling is per SECTION 31 62 16.13.
- c. For protection of sheet piling, coat it in accordance with Section 09 97 13.26 COATING OF STEEL WATERFRONT STRUCTURES and provide cathodic protection in accordance with Section 26 42 13 GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM.

2.1.1 Interlocks

The interlocks of piling must be free-sliding, provide a swing angle

suitable for the intended installation but not less than 5 degrees when interlocked, and maintain continuous interlocking when installed.

2.1.2 General Requirements

Provide sheet and pipe piles with minimum section modulus, moment of inertia, shape, and size as specified in the drawings. Sheet piling including special fabricated sections must be full-length sections of the dimensions shown. Metalwork fabrication for sheet piling must be as specified and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.2 APPURTENANT METAL MATERIALS

Provide steel plates, shapes, bolts, nuts, Headed Anchor Studs (Welded Studs) and other appurtenant fabrication and installation materials conforming to manufacturer's standards and to the requirements specified in the respective sheet piling standards and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

Requirements for material tests, workmanship and other measures for quality assurance must be as specified and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Provide manufacturer's steel plant certificate for Government review and approval.

2.3.1 Materials Tests

Submit certified materials tests reports showing that pipe piling, sheet piling and appurtenant metal materials meet the specified requirements, for each shipment and identified with specific lots prior to installing materials. Material test reports must meet the requirements of ASTM A6/A6M. Perform materials tests conforming to the following requirements. Sheet piling, pipe piling, and appurtenant materials must be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property requirements prior to delivery to the site. Testing of sheet piling, and pipe piling for mechanical properties must be performed after the completion of all rolling, welding and forming operations. Testing of pipe and sheet piling must meet the requirements of ASTM A6/A6M.

2.4 PILE DRIVING EQUIPMENT

Submit complete descriptions of sheet piling driving equipment including hammers, extractors, protection caps and other installation appurtenances, prior to commencement of work. Descriptive information includes manufacturer's name, model numbers, capacity, rated energy, hammer details, cushion material, helmet, and templates. Provide pile driving equipment conforming to the following requirements. Submit descriptions of pile driving equipment, including hammers, power packs, driving helmets, hammer cushions, pile cushions, leads, extractors, jetting equipment, and preboring equipment at least 30 days prior to commencement of work.

2.4.1 Driving Hammers

Hammers must be steam, air, or diesel drop, single-acting, double-acting, differential-acting, or vibratory type. The driving energy of the hammers must be as recommended by the manufacturer for the piling weights and

subsurface materials to be encountered. Repair damage to piling caused by use of a pile hammer with excess delivered force or energy.

2.4.2 Jetting Equipment

Jetting will not be permitted.

2.4.3 Drilling Equipment

Provide drill rigs for pile installation with suitable drilling bits, core barrels, augers, rock bits, and/or other suitable equipment to drill through stone, silt, clay, sand, gravel, concrete debris, hard cobbles and hard boulders, to the specified tip elevations. Provide drilling equipment with sufficient torque and downward thrust ("crowd") to excavate and drill through the material indicated to the specified tip elevation as indicated.

The use of jetting for drilling is prohibited.

Drilling equipment and methods must be approved by the Contracting Officer prior to commencing drilling operations.

Provide two-level steel templates constructed out of wide flange beams and channels, or other suitable materials to ensure proper location and vertical alignment during drilling and pile installation. The templates must be securely supported and anchored or weighed down to minimize movement during drilling and pile installation.

Provide a drilling equipment submittal for Government review and approval.

PART 3 EXECUTION

3.1 PRELIMINARY WORK

3.1.1 Pile Length Markings

Mark each pile prior to driving with horizontal lines at one foot intervals. Mark the interval number on pile every 5 feet from pile tip.

3.2 EARTHWORK

Perform in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL. Pre-excavation will be permitted. Backfill as indicated.

3.3 INSTALLATION

3.3.1 Placing and Driving

3.3.1.1 Placing

Submit a written description of the site specific pile installation procedures for Government review and approval. Pile placement installation drawings and details must also be provided.

Any excavation required within the area where sheet pilings are to be installed must be completed prior to placing sheet pilings. Pilings properly placed and driven must be interlocked throughout their length with adjacent pilings to form a continuous diaphragm throughout the length or run of piling wall.

- a. Pilings must be carefully located as indicated. Pilings must be placed plumb with out-of-plumbness not exceeding 1/4 inch per foot of length and true to line. Place the pile so the face will not be more than 6 inches from vertical alignment at any point. Top of pile at elevation of cut-off must be within 1/2 inch horizontally and 2 inches vertically of the location indicated. Manipulation of piles to force them into position will not be permitted. Check all piles for heave. Re-drive all heaved piles to the required tip elevation.
- b. Provide temporary wales, templates, or guide structures to ensure that the pilings are placed and driven to the correct alignment. Use a system of structural framing sufficiently rigid to resist lateral and driving forces and to adequately support the sheet piling until design tip elevation is achieved. Use two templates, at least, when placing each piling. Templates must not move when supporting sheet piling. Fit templates with wood blocking to bear against the web of each alternate sheet pile and hold the sheet pile at the design location alignment. Provide outer template straps or other restraints as necessary to prevent the sheets from warping or wandering from the alignment. Mark template for the location of the leading edge of each alternate sheet pile. If in view, also mark the second level to assure that the piles are vertical and in position. If two guide marks cannot be seen, other means must be used to keep the sheet pile vertical along its leading edge.

3.3.1.2 Predrilling or "Core Beam"

Predrilling to remove soil or other material representing the bulk of the profile of the sheet piling to be driven will be permitted. The diameter of the hole must not exceed 8 inches. Discontinue drilling when the pile tip is approximately 1 foot above the indicated pile tip elevation. Drive pile the final 1 foot of penetration.

In lieu of predrilling the king piles per 31 62 16.13 STEEL PIPE PILES may be reinforced with a contractor designed "core beam". The "core beam" must provide a uniform wall section modulus of 52.0 inches cubed per lineal foot of bulkhead, the intent of the core beam is to provide sufficient strength if the sheet piling cannot penetrate the glacial till. The top of the glacial till will be per the boring, and the indicator pile program. If the "core beam" concept is used then the extents of the core beam will be 3 ft above the glacial till elevation, to 3 feet below the indicated minimum sheet pile tip elevation. If the "core beam" option is selected, then submit registered engineer signed and sealed calculations and drawings to the Contracting Officer. The "core beam" may be constructed from WT sections, if stiffening is required it should be placed on the outside face of the king pile.

3.3.1.3 Driving

Submit records of the completed sheet piling driving operations, including a system of identification which shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations of installed piling. Prior to driving pilings in water, paint a horizontal line on both sides of each piling at a fixed distance from the bottom so that it will be visible above the water line after installation. This line must indicate the profile of the bottom elevation of installed pilings and potential problem areas can be identified by abrupt changes in its elevation. Drive pilings with the proper size hammer and by approved

methods so as not to subject the pilings to damage and to ensure proper interlocking throughout their lengths.

- a. Maintain driving hammers in proper alignment during driving operations by use of leads or guides attached to the hammer. Caution must be taken in the sustained use of vibratory hammers when a hard driving condition is encountered to avoid interlock-melt or damages. Discontinue the use of vibratory hammers and impact hammers employed when the penetration rate due to vibratory loading is one foot or less per minute.
- b. Employ a protecting cap in driving when using impact hammers to prevent damage to the tops of pilings. Use cast steel shoe to prevent damage to the tip of the sheet piling. Submit pile shoe installation details and material data for Government review and approval prior to use in the field. Remove and replace pilings damaged during driving or driven out of interlock at the Contractor's expense.
- c. Drive pilings without the aid of a water jet.
- d. Take adequate precautions to ensure that pilings are driven plumb. Where possible, drive Z-pile with the ball end leading. If an open socket is leading, a bolt or similar object placed in the bottom of the interlock will minimize packing material into it and ease driving for the next sheet. If at any time the forward or leading edge of the piling wall is found to be out-of-plumb in the plane of the wall the piling being driven must be driven to the required depth and tapered pilings must be provided and driven to interlock with the out-of-plumb leading edge or other approved corrective measures must be taken to insure the plumbness of succeeding pilings. The maximum permissible taper for any tapered piling must be 1/8 inch per foot of length.
- e. Pilings in each run or continuous length of piling wall must be driven alternately in increments of depth to the required depth or elevation. No piling will be driven to a lower elevation than those behind it in the same run except when the pilings behind it cannot be driven deeper. Incrementally sequence driving of individual piles such that the tip of any sheet pile must not be more than 4 feet below that of any adjacent sheet pile. When the penetration resistance exceeds five blows per inch, the tip of any sheet pile must not be more than 2 feet below any adjacent sheet pile. If the piling next to the one being driven tends to follow below final elevation it may be pinned to the next adjacent piling.
- f. If obstructions restrict driving a piling to the specified penetration, the obstructions must be removed or penetrated with a chisel beam. If the Contractor demonstrates that removal or penetration is impractical, make changes in the design alignment of the piling structure as directed to ensure the adequacy and stability of the structure. Pilings must be driven to depths shown and must extend up to the elevation indicated for the top of pilings. Pilings must not be driven within 100 feet of concrete less than 7 days old.
- g. Pre-augering or spudding of piles may be used at no additional cost to the Government. Discontinue pre-augering or spudding approximately 5 feet above the indicated pile tip elevation. Drive the pile the final 5 feet of penetration.

3.3.2 Cutting-Off and Splicing

Pilings driven to refusal or to the point where additional penetration cannot be attained and are extending above the required top elevation in excess of the specified tolerance must be cut off to the required elevation. Pilings driven below the required top elevation and pilings damaged by driving and cut off to permit further driving must be extended as required to reach the top elevation by splicing when directed at no additional cost to the Government. Submit procedure for insufficient pile length. Provide pile splicing information and details for Government review and approval prior to installation in the field.

- a. The tops of pilings excessively damaged during driving must be trimmed when directed, at no cost to the Government. Piling cut-offs will become the property of the Contractor and must be removed from the site.
- b. Cut holes in pilings for bolts, rods, drains or utilities in a neat and workmanlike manner, as shown or as directed. Use a straight edge in cuts made by burning to avoid abrupt nicks. Bolt holes in steel piling must be drilled or may be burned and reamed by approved methods which will not damage the surrounding metal. Holes other than bolt holes must be reasonably smooth and the proper size for rods and other items to be inserted. Do not use explosives for cutting.

3.3.3 Inspection of Driven Piling

Perform continuous inspection during pile driving. Inspect all piles for compliance with tolerance requirements. Bring any unusual problems which may occur to the attention of the Contracting Officer. Inspect the interlocked joints of driven pilings extending above ground. Use divers to inspect underwater interlocked joints at 25-, 50-, 75-, and 100-percent completion. Pilings found to be out of interlock must be removed and replaced at the Contractor's expense.

3.3.4 Pulling and Redriving

Submit the proposed method of pulling sheet piling, prior to pulling any piling. Pull, as directed, selected pilings after driving to determine the condition of the underground portions of pilings. Any piling so pulled and found to be damaged, to the extent that its usefulness in the structure is impaired, must be removed and replaced at the Contractor's expense. Pilings pulled and found to be in satisfactory condition must be redriven when directed.

3.3.5 Survey Data

After the driving of each pile group is complete and before superimposed concrete is placed, provide the Contracting Officer with an as-driven survey showing actual location and top elevation of each pile. Submit an as-driven survey showing actual location and top elevation of each production pile within 7 calendar days of completing the pile installation. Do not proceed with placing concrete until the Contracting Officer has reviewed the survey and verified the safe load for the pile group driven. Present a survey in such form that it gives deviation from plan location in two perpendicular directions and elevations of each pile to nearest half inch. Survey must be prepared and certified by a land surveyor licensed in Rhode Island.

3.4 DRAINAGE

Backfill material behind the sheet piling must be free draining, wrapped in geotextile and in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

3.5 CATHODIC PROTECTION

After bulkhead piling is installed, field weld all interlocks per the PILE BONDING Subpart, and install Anodes per the INSTALLATION Subpart of Section 26 42 13 GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM.

3.6 REMOVAL

The removal of sheet pilings must consist of pulling, sorting, cleaning the interlocks, inventorying and storing previously installed sheet pilings as shown and directed.

3.6.1 Pulling

The method of pulling piling must be approved. Provide pulling holes in pilings, as required. Extractors must be of suitable type and size. Care shall be exercised during pulling of pilings to avoid damaging piling interlocks and adjacent construction. If the Contracting Officer determines that adjacent permanent construction has been damaged during pulling, the Contractor will be required to repair this construction at no cost to the Government. Pull pilings one sheet at a time. Pilings fused together must be separated prior to pulling, unless the Contractor demonstrates, to the satisfaction of the Contracting Officer, that the pilings cannot be separated. The Contractor will not be paid for the removal of pilings damaged beyond structural use due to proper care not being exercised during pulling.

3.6.2 Sorting, Cleaning, Inventorying and Storing

Pulled pilings must be sorted, cleaned, inventoried and stored by type into groups as:

- a. Piling usable without reconditioning.
- b. Piling requiring reconditioning.
- c. Piling damaged beyond structural use.

3.7 Bulkhead Test Piles

Bulkhead test piles, may be sacrificial Pipe Piles, or uncoated production pipe (king) piles installed as indicated, to verify king pile tip elevation along the length of the bulkhead from the T-Pier to the Rock Jetty. Drilling or pre-augering may be required to Extraction or abandon the piles as indicated, See also SECTION 31 62 16.13 and note that PDA or CAPWAP is not required for bulkhead (king) test piles.

3.8 INSTALLATION RECORDS

Maintain a pile driving record for each production and test pile driven. Indicate on the installation record: installation dates and times, type and size of hammer, rate of operation, total driving time, dimensions of driving helmet and cap used, blows required per foot for each foot of

penetration, final driving resistance in blows for final 6 inches, pile locations, tip elevations, ground elevations, cut-off elevations, and any reheading or cutting of piles. Record any unusual pile driving problems during driving. A preprinted pile driving log for recording pile driving data and pile driving equipment data form, which can be downloaded at: <http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>. Submit draft pile driving records within 14 days of pile installation, and complete final pile driving records to the Contracting Officer within 28 days of completion of all bulkhead pile driving operations..

-- End of Section --

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SECTION 31 62 16.13

STEEL PIPE PILES

11/20

PART 1 GENERAL

1.1 DESCRIPTION

The work under this section consists of requirements for materials, installation, and testing of bearing and fender piles at the trestle, pier, and floating dock. Furnish, install and test steel pipe piles at the locations indicated on the drawings and specified herein. Assume test piles will be placed in locations that can be incorporated into the work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5L (2018; 46th Ed; ERTA 2018) Line Pipe

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding Code - Steel

AWS D1.5M/D1.5 (2020) Bridge Welding Code

ASTM INTERNATIONAL (ASTM)

ASTM A6/A6M (2021) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A109/A109M (2016; R 2018) Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled

ASTM A139/A139M (2016) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)

ASTM A148/A148M (2020; E 2020) Standard Specification for Steel Castings, High Strength, for Structural Purposes

ASTM A252 (2010) Standard Specification for Welded

and Seamless Steel Pipe Piles

ASTM A572/A572M	(2021; E 2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A1018/A1018M	(2016a) Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM D4945	(2017) Standard Test Method for High-Strain Dynamic Testing of Deep Foundations
ASTM E94/E94M	(2017) Standard Guide for Radiographic Examination Using Industrial Radiographic Film
ASTM E164	(2019) Standard Practice for Contact Ultrasonic Testing of Weldments
ASTM E165/E165M	(2018) Standard Practice for Liquid Penetrant Examination for General Industry
ASTM E329	(2021) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E709	(2021) Standard Guide for Magnetic Particle Testing

1.3 SUBSURFACE DATA

Subsurface soil data logs are provided on the project drawings. These samples are being retained by the Navy. The location is transient, but can be made available.

1.3.1 Contractor's Geotechnical Consultant

Hire the services of an independent, Registered Professional Geotechnical Engineer, experienced in soil mechanics and Pile Dynamic Analysis, to observe test pile installation as specified herein. The Contractor's Geotechnical Consultant must be independent of the Contractor and must have no employee or employer relationship, which could constitute a conflict of interest. Submit qualifications at least 30 calendar days prior to pile installation. Provide instructions and procedures on how the Geotechnical Consultant will assist the Government with Dynamic Pile Testing, Inspection, and Monitoring of piles during installation and testing.

1.4 BASIS OF BID

For unit price bid, see PRICE SCHEDULE.

Requirements of FAR 52.211-18 "Variation in Estimated Quantity" must not apply to payment for piling. Each pile and test pile acceptably provided will be paid for at the bid unit price per unit length, which price shall include items incidental to furnishing and driving the piles including: mobilization and demobilization, predrilling, probing, redriving uplifted piles, and cutting off piles at the cutoff elevation. Payment must be made for production and test piles at the bid unit price for the length of pile, from tip to final cutoff, actually provided, excluding splices directed by the Contracting Officer to be made. Should the actual cumulative pile length driven (tip to cutoff) vary more than 25 percent from the total pile length specified as a basis for bidding, at the direction of the Contracting Officer, the unit price per unit length will be adjusted in accordance with provisions of FAR 52.236-2 "Differing Site Conditions."

1.4.1 Pulled Piles

Piles required to be pulled at no fault of the Contractor will be paid for at the bid unit price for furnishing and driving the pile in its original position plus 25 percent of the amount to cover the cost of pulling. Such pulled piles when redriven will be paid for at 25 percent of the bid unit price for the length driven.

1.4.2 Pile Load Test

Payment for each acceptably provided complete dynamic test loading of a single pile including restrike if required will be made at the contract unit price per test, which price shall include furnishing, placing, and removing testing equipment. At the direction of the Contracting Officer, load tests may be waived at a credit to the Government of the unit price bid therefore.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installation Procedures; G

Contractor's Geotechnical Consultant Qualification; G

Testing Agency Qualifications; G

Wave Equation Analysis; G

SD-02 Shop Drawings

Piles; G

Pile Splices; G

Pile Placement; G

As-Driven Survey; G

Pile Shoes; G

SD-03 Product Data

Pile Driving Equipment; G

SD-05 Design Data

Quantities List; G

SD-06 Test Reports

Test Piles; G

Dynamic Pile Analysis; G

SD-07 Certificates

Pile Shoes; G

Welder Certification; G

Steel Plant Certification; G

Mill Certificates

Fabricator's Certification

Welder Qualifications; G

SD-11 Closeout Submittals

Pile Records; G

1.6 DELIVERY, STORAGE, AND HANDLING

Conform all delivery, storage, and handling of materials to the requirements specified herein. Develop and submit plans for the delivery, storage, and handling of piles. Submit plans at least 30 calendar days prior to delivery of piles to the job site.

1.6.1 Delivery and Storage

Stack piles during delivery and storage so that each pile is maintained in a straight position and is supported every 10 feet or less along its length and not more than 2 feet from the ends.

1.6.2 Handling

Lift piles to ensure that the maximum permissible curvature is not exceeded. Point pick-up devices must be of the type that clamp to both pile flanges at each pick-up point. Holes may be burned above the cutoff length for lifting piles into the leads. If there is evidence of pile damage during driving due to the holes, Contracting Officer may forbid the burning of holes. Do not damage piles when dragging piles across the ground or barge deck.

Inspect piles for excessive curvature and for damage before transporting

them from the storage area to the driving area and immediately prior to placement in the driving leads. Curvature in the pile must be measured with the pile laying on a flat surface and is the distance between the pile at the mid-length of the pile and the flat surface. Straightness of the sections of steel pipe piles must conform to AWS D1.5M/D1.5, Section 3.5.1.1. Piles having excessive curvature will be rejected.

1.6.3 Damaged Piles

Inspect each pile for straightness and structural damage before transporting them to the project site and immediately prior to placement in the driving leads. Bring any damage to the attention of the Contracting Officer. Piles which are damaged during delivery, storage, or handling to the extent they are rendered unsuitable for the work, in the opinion of the Contracting Officer, will be rejected and removed from the project site, or may be repaired, if approved, at no cost to the Government.

Any pile damaged by reason of internal defects or by improper driving must be corrected by one of the following methods approved by the Engineer for the pile in question:

- a. The pile is withdrawn, if practicable, and replaced by a new and, if necessary, longer pile.
- b. One or more replacement piles are driven adjacent to the defective pile.
- c. A Pile Dynamic Analysis and low integrity testing must be performed by the Contractor's Geotechnical Consultant to assess the structural integrity of the driven pile(s).

A pile driven below the specified butt elevation must be corrected by the following methods approved by the Contracting Officer:

- a. The pile is spliced (if approved).
- b. A sufficient portion of the reinforced pile cap is extended down to properly embed the pile. Design of this extension must be submitted to the Contracting Officer for approval.

A pile driven out of its proper location or out of plumb as approved by the Engineer, must be corrected by one of the following methods approved by the engineer:

- a. One or more replacement piles are driven next to the pile in question.
- b. As directed by the structural engineer.

1.7 QUALITY ASSURANCE

1.7.1 Fabricator's Certification

Manufacturers of steel pipe shall be certified by the Steel Plate Fabricator's Association (SPFA) when plates are used to fabricate pipe.

1.7.2 Mill Certificates

For each shipment, submit certificates identified with specific lots prior

to installing piling. Include in the identification data piling type, dimensions, chemical composition, mechanical properties, section properties, heat number, and mill identification mark.

1.8 QUALITY CONTROL

1.8.1 Piles

Prepare and submit shop drawings for piles. Indicate placement of piles. Indicate location of special embedded or attached lifting devices, employment of pick-up points, support points other than pick-up points, and any other methods of pick-up. Perform quality control testing of the concrete infill in accordance with Section 03 31 30 MARINE CONCRETE.

1.8.2 Installation Procedures

- a. Submit information on the type of equipment proposed to be used, proposed methods of operation, pile driving plan including proposed sequence of driving, and details of all pile driving equipment and accessories. Submit descriptions of pile driving equipment, including hammers, power packs, driving helmets, hammer cushions, pile cushions, leads, extractors, jetting equipment, and preboring equipment at least 30 calendar days prior to commencement of work.
- b. Provide details of pile driving equipment and a Wave Equation Analysis of pile drivability for selection of the hammer along with a statement of driving procedures. Provide instructions and procedures on how the Contractor will perform Dynamic Pile Testing, Inspection and Monitoring of piles during installation and testing. The Wave Equation Analysis is to be completed by the Contractor's Geotechnical Consultant for each test pile location where different subsurface conditions exist and is to include the following information pertaining to the proposed pile driving equipment:
 - (1) Complete Pile and Driving Equipment Data Form, (which can be downloaded at: <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>) for each proposed pile hammer and pile type combination.
 - (2) Copies of computer input and output sheets and graphs showing soil resistance versus blow count as well as maximum tension and compression stresses versus blow count. Analysis must be run at the estimated tip elevation as well as other required elevations to define maximum stress levels in the pile during driving.
- c. Provide detailed procedures for conducting the dynamic pile load test and equipment to be used for conducting the load test. The detailed description must explain proposed locations of indicator and test piles, and how specific information of pile performance will be evaluated.

PART 2 PRODUCTS

2.1 PILE REQUIREMENTS

Test piles must be a minimum of 5 feet longer in length than indicated production pile bid length. Drive the additional test pile length only when based upon the recommendation of the Contractor's Geotechnical Consultant and approved by the Contracting Officer. The Contractor's

Geotechnical Consultant will use test pile data to determine "calculated" pile tip elevation and necessary driving resistance. This information will be given to the Contractor no later than 7 days from receipt of complete test data. Use this list as the basis for ordering the piles. Do not order piles until list is provided by the Contractor's Geotechnical Consultant.

2.2 MATERIALS

2.2.1 Steel Pipe Piles

Provide steel pipe piles of the shape, size and sections shown in the drawings. Pipe piles must be either seamless pipe or complete joint penetration welded with straight or spiral seams. Pipe must be welded in a manner that welding will not crack or fail when the pile is subjected to its intended use, including during installation. The weld seam of each length of pipe must be tested for acceptance by ultrasonic testing in accordance with the provisions for Nondestructive Electric Test of Weld Seam of ASTM A53/A53M.

- a. Pipe piles must have a minimum yield strength of 60 ksi and conform to one of the following:
 - (1) ASTM A252, Grade 3 Modified, fabricated from base metal conforming to ASTM A572/A572M or ASTM A1018/A1018M. Helical-lap seams are not permitted.
 - (2) ASTM A139/A139M, Grade E Modified, except that hydrostatic testing is not required.
 - (3) API Spec 5L, Grade X60 or better, and must be manufactured, welded, tested, and inspected at a plant licensed to apply the API monogram. Hydrostatic testing, flattening tests, and application of the API monogram are not required.
- b. Base metal for pipe piles must meet the following ASTM A6/A6M Standard Supplementary requirements:
 - (1) S5 - The steel must have a minimum absorbed energy of 25 ft-lb at +10 degrees F. Perform two tests per heat.
 - (2) S31 - The steel must have a maximum carbon equivalent of 0.45.
- c. Submit certified materials tests reports showing that piling materials meet the specified requirements, for each shipment and identified with specific lots prior to installing materials. Material test reports must meet the requirements of ASTM A6/A6M. Perform materials tests conforming to the following requirements. Piling materials must be tested and certified by the manufacturer to meet the specified chemical, mechanical section, and any other physical property requirements prior to delivery to the site. Testing of piling for mechanical properties must be performed after the completion of all rolling and forming operations. Testing of piling must meet the requirements of ASTM A6/A6M.

2.2.1.1 Dimensional Tolerances

- a. Outside Diameter - The outside diameter of pipe piles must not vary more than +/- 0.75 percent from the specified outside diameter.

- b. Outside Circumference - The outside circumference of each pipe end must not vary by more than 0.75 percent from the specified circumference.
- c. Straightness - The straightness, in units of inches, must not exceed 0.001 times the length of pile.
- d. Variation in Edge Alignment - The maximum allowable variation in edge alignment for adjacent steel pipe ends to be welded must be 0.1875 times the wall thickness, but not more than 0.063 inch.
- e. Wall Thickness - The minimum wall thickness must be as indicated on the Contract Drawings.

2.2.1.2 Weld Processes

Welds made at a permanent manufacturing facility must be performed by either an automatic fusion weld process or an electric resistance weld process. Weld in conformance with AWS D1.1/D1.1M including a pre-approved complete joint penetration weld in accordance with AWS with a 1/16 inch alignment requirement. Seam welds shall be full penetration welds developing the strength of the base metal. Submit WPS for non-listed base metals.

2.2.2 Pile Splices

Submit detail drawings of shop and field pile splices prior to fabrication. Provide ASTM A148/A148M Grade 90-60 proprietary pile splicer sleeves or provide ASTM A109/A109M or ASTM A36/A36M backing rings to prevent weld blow out during weld process. Rings may be split into two pieces.

2.2.3 Pile Shoes

Submit details about pile shoes used. ASTM A148/A148M Grade 90/60 for cast steel cutting shoe. Submit Certificates of compliance certifying that materials meet the requirements specified herein. Provide outside flange open end cutting shoe on all pipe piles. Perform all welding in accordance with the requirements for pile splices.

2.2.4 Fabrication

Fabrication must conform to the requirements shown and as specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Submit steel plant certification.

2.2.4.1 Pile Splices

Perform all welding in accordance with the requirements for shield metal arc welding of AWS D1.1/D1.1M. Submit welding procedure for shop splices and verification of welder certification and Welder Qualifications. Make no more than one field splice per 80 feet of pile, unless directed by the Contracting Officer. Fabrication drawings must show all shop splices.

Only use welders qualified by tests prescribed by AWS D1.1/D1.1M.

Splice sections of pipe with an approved complete joint penetration butt or single bevel-groove weld. Both pipe ends must be square cut and seated

to bear. Use an approved jig or alignment device during welding to maintain the required straightness of pipe. Field splices must be minimized or eliminated if possible. No splices will be allowed in the top 30 feet of pile to eliminate coating vulnerability, unless directed by the Contracting Officer. For splices made during pile installation, rigid frame pile leads may be used as a jig in a manner approved by the Contracting Officer.

See paragraph FIELD QUALITY CONTROL for requirements.

2.2.4.2 HDPE Pipe Pile Sleeves

Provide HDPE Pipe Pile Sleeves after pile installation in accordance with Section 35 59 20 HDPE PIPE PILE SLEEVES

2.2.4.3 Coating of Piles

Steel pipe piles must be coated in accordance with Section 09 97 13.26 COATING OF STEEL WATERFRONT STRUCTURES.

2.2.5 Concrete Infill

Concrete infill must conform to the requirements as identified in the Sections 03 31 30 MARINE CONCRETE. Submit a concrete mix design at least 30 calendar days before concrete is placed, for each type of concrete used for the piles. Material certifications and test data for aggregates, admixtures, cement, fly ash and pozzolans must be provided. Submit concrete compressive strength test results. Minimum compressive strength is 5,000 psi.

2.3 PILE DRIVING EQUIPMENT

Select the proposed pile driving equipment, including hammers and other required items, and submit complete descriptions of the proposed equipment in accordance with paragraph SUBMITTALS. Final approval of the proposed equipment is subject to the satisfactory completion and approval of pile tests. Changes in the selected pile driving equipment will not be allowed after the equipment has been approved except as directed by the Contracting Officer. No additional contract time will be allowed for Contractor proposed changes in the equipment.

2.3.1 Pile Driving Hammers

Provide impact and vibratory type pile driving hammers.

2.3.1.1 Impact Hammers

Provide air, hydraulic or diesel-powered impact pile hammers of the single-acting, double-acting, or differential-acting type. The size or capacity of hammers must be in accordance with the results of Wave Equation Analysis. Provide boiler, compressor, or engine capacity sufficient to operate hammers continuously at the full rated speed. Hammers must have a gage to monitor hammer bounce chamber pressure for diesel hammers or pressure at the hammer for air hammers. This gage must be operational during the driving of piles and be mounted in an accessible location for monitoring by the Contractor and the Contracting Officer. Hydraulic hammers must be equipped with a system for measurement of ram energy. The system must be in good working order and the results must be easily and immediately available to the Contracting Officer. Install an energy

monitor on the hydraulic hammer and record reading every 12 inches of pile installation. Use wave equation analysis to verify that the hammer will develop stresses within acceptable limits in the piles. Position a pile cap or drive cap between the pile and hammer. Place hammer cushion or cap block between ram and the pile cap or drive cap. Hammer cushion or cap block must have consistent elastic properties, minimize energy absorption, and transmit hammer energy uniformly and consistently during the entire driving period. In accordance with paragraph SUBMITTALS, submit the following information for each impact hammer proposed:

- a. Make and model.
- b. Ram weight (pounds).
- c. Anvil weight (pounds).
- d. Rated stroke inches.
- e. Rated energy range foot-pounds.
- f. Rated speed (blows per minute).
- g. Air pressure, hammer, and boiler or compressor psi.
- h. Rated bounce chamber pressure curves or charts, including pressure correction chart for type and length of hose used with pounds per square inch.h. Pile driving cap, make, and weight (pounds).
- i. Cushion block dimensions and material type.
- j. Power pack description.

2.3.1.2 Vibratory Hammers

A vibratory hammer may be used to probe and set the pile at the plan location. Final approval of the proposed hammer and other driving equipment is subject to the satisfactory completion and approval of the pile tests. The size or capacity of hammers must be in accordance with the results of Wave Equation Analysis. The hammer must provide for maintaining a rigid connection between the hammer and the pile. In accordance with paragraph SUBMITTALS, submit the following information for each vibratory hammer proposed:

- a. Make and model.
- b. Eccentric moment (inch-pounds).
- c. Dynamic force (tons).
- d. Steady state frequency or frequency range (cycles per minute).
- e. Vibrating weight (pounds).
- f. Amplitude (inches).
- g. Maximum pull capacity (tons).
- h. Non-vibrating mass weight (pounds).

- i. Power pack description.

2.3.2 Pile Driving Leads

Support and guide hammers with fixed extended leads or fixed underhung leads. Provide two intermediate supports for the pile in the leads to reduce the unbraced length of the pile during driving and pulling. Vibratory hammers may be operated free hanging without leads.

2.3.3 Pile Extractors

Pile extractors may be vibratory or impact pile driving hammers. Impact hammers are required for pulling piles not extractable with vibratory hammers.

PART 3 EXECUTION

3.1 PRELIMINARY WORK

3.1.1 Wave Equation Analysis of Pile Drivability

- a. Prior to driving any pile, submit a pile Wave Equation Analysis, performed by Contractor's Geotechnical Consultant, for each size pile and distinct subsurface profile condition. These analyses must take into account the proposed hammer assembly, pile cap block and cushion characteristics, the pile properties and estimated lengths and the soil properties anticipated to be encountered throughout the installed pile length based on static capacity analysis with consideration of driving gain/loss factors. Only one specific model of pile hammer may be used for each pile type and capacity.
- b. Demonstrate using the Wave Equation Analysis that the piles will not be damaged during driving, indicate that the driving stresses will be maintained within the limits below and indicate the blow count necessary to achieve the required ultimate static pile capacities.

Allowable Driving Stresses

Steel Piles

Compression - 0.9 fy
Tension - 0.9 fy

Where fy is yield strength of steel

- c. Perform a refined Wave Equation Analysis upon completion of the dynamic with signal matching (CAPWAP) testing program outlined in this specification section, taking into consideration the evaluated capacities, gain/loss factors and recommended production pile lengths. Develop production pile driving criteria based on the results of the refined Wave Equation Evaluations, considering re-strike data.
- d. All pile driving equipment provided by the Contractor will be subject to the approval of the Contractor's Geotechnical Consultant. Complete the attached pile and driving equipment data form, including hammer information, in full as part of the submittal of the results of the Wave Equation Analyses.
- e. Pay for the cost of performing the Wave Equation Analyses and include

in the base bid.

3.1.2 Order List

Submit to the Contracting Officer for approval, an itemized quantities list for piles prior to placing the order with the supplier. Indicate the pile lengths required at each location as shown on the plans and the corresponding ordered length of each pile in the list. Complete dynamic load testing and refined wave equation analysis and submit to Government for review and approval prior to submission of an order list.

3.2 INSTALLATION

Inspect piles when delivered and when in the leads immediately before driving. Cut piles at cutoff grade by an approved method. Where cutoff is below existing ground or mudline elevation, complete excavation, sheeting, and dewatering before driving pile to driving criteria.

3.2.1 Lengths of Production Piles

The estimated quantities of piles are given for bidding purposes only. Drive piles to or below "calculated" tip elevation to reach a driving resistance established by the wave equation analyses (WEAP) in accordance with the schedule which the Contractor's Geotechnical Consultant will prepare from the test-pile driving data.

3.2.2 Pile Driving Records

Contractor's Geotechnical Engineer must keep a complete and accurate record of each pile driven. Indicate the pile location, deviations from pile location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut-off elevations, number of blows required for each foot of penetration and number of blows for the last 6 inches penetration or fraction thereof. Include in the record the beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used. Record retap data and unusual occurrences during pile driving such as re-driving, heaving, weaving, splicing, obstructions, and any driving interruptions. A preprinted pile driving log for recording pile driving data and pile driving equipment data form, which can be downloaded at: <https://www.wbdg.org/ffcc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>.

3.2.3 Pile Placement and Tolerances in Driving

Develop and submit a pile placement plan which shows the installation sequence and the methods proposed for controlling the location and alignment of piles. Submit pile placement plans at least 30 calendar days prior to delivery of piles to the job site. Complete all foundation preparation in the area prior to the placement of piles for driving. Accurately place piles in the correct location and alignments, both laterally and longitudinally, and to the vertical or batter lines indicated. Establish a permanent base line to provide for inspection of pile placement by the Contracting Officer during pile driving operations prior to driving production piles and maintain during the installation of the production piles.

A final lateral deviation from the correct location at the cutoff

elevation of not more than 3 inches will be permitted for vertical piles. Manipulation of piles will not be permitted. A variation of not more than 0.25 inch per foot of pile length from the vertical for vertical piles will be permitted. In addition to complying with the tolerances stated herein, the clear distance between the heads of piles and the edges of caps must be not less than 6 inches. With prior approval of the Contracting Officer, the Contractor may provide additional concrete and reinforcement to maintain the required minimum clear distance. Redesign of pile caps or additional work required due to improper location of piles is the responsibility of the Contractor. A vertical deviation of not more than 1/2 inch from the correct cutoff elevations shown is permitted. Inspect piles for heave. Redrive heaved piles to the required pile driving criteria. Maintain the correct relative position of all piles by the use of templates or by other approved means. Piles damaged or not located properly or exceeding the maximum limits for lateral and vertical deviation, or variation in alignment must be pulled and new piles redriven, or provide additional piles, at a location directed at no additional cost to the Government.

3.2.3.1 Survey Data

After the driving of each pile group is complete and before superimposed concrete is placed, provide the Contracting Officer with an as-driven survey showing actual location and top elevation of each pile. Submit the as-driven survey showing actual location and top elevation of each production pile within 7 calendar days of completing the pile installation. Do not proceed with placing concrete until the Contracting Officer has reviewed the survey and verified the piles have been installed per these specifications.. Present a survey in such form that it gives deviation from plan location in two perpendicular directions and elevations of each pile to nearest half inch. Survey must be prepared and certified by a land surveyor licensed in Rhode Island.

3.2.4 Pile Penetration Criteria

The controlling driving resistance for production piles will be determined by the Contractor's Geotechnical Consultant. The required initial driving criteria and restrrike will be established subsequent to the analysis of pile tests as specified in paragraph TEST PILES.

3.2.5 Pile Length Markings

Mark each pile prior to driving with horizontal lines at one foot intervals. Mark each pile every inch within the last 10 feet of anticipated tip penetration. Mark the inch interval number on pile every 5 feet from pile tip.

3.2.6 Pile Driving

Notify Contracting Officer 10 calendar days prior to driving of test piles. Submit records for test piles. The Contractor's Geotechnical Consultant will determine the terminal driving criteria based on results of dynamic pile driving tests at the end of drive or restrrike. Do not drive piles within 100 feet of concrete less than 7 days old. Complete excavation to lines and grades shown when pile driving is completed. Drive piles to indicated minimum tip elevation and to reach a driving resistance established by the dynamic pile driving tests at the end of drive or restrrike in accordance with the schedule which the Contractor's Geotechnical Consultant will prepare from the test-pile driving data.

During initial driving and until pile tip has penetrated beyond layers of very soft soil or below bottom of predrilledholes, use a reduced driving energy of the hammer as required to prevent pile damage. Refusal criteria will be established by the Contractor's Geotechnical Consultant. If a pile fails to reach indicated minimum tip elevation without reaching required driving resistance, notify Contracting Officer and perform corrective measures as directed. Provide hearing protection when noise levels exceed 140 dB. Do not handle or move piles or pile sections in any manner that would result in cracking or permanent damage to the concrete or to the grout surrounding the prestressing cables. Piles may be driven without pile guides or leads providing a hammer guide frame is used to keep the pile and hammer in alignment.

3.2.7 Protection of Piles

Take care to avoid damage to piles during handling, placing pile in leads, and during pile driving operations. Support piles laterally during driving, but allow rotation in leads. Maintain axial alignment of pile hammer with that of the pile.

3.2.8 Rejected Piles

Withdraw piles damaged or impaired for use during handling or driving, mislocated, or driven out of alignment beyond the maximum tolerance. Replace with new piles or cut-off and abandon damaged or impaired piles and drive new piles as directed. Remove excess cut-off from piles and unacceptable piles from the work site. Perform all work in connection with withdrawing and removing rejected piles from the site at no additional cost to the Government. Abandoned upland piles must be cutoff at least 6 ft below final grade, abandoned marine piles must be cutoff at least 2 ft below the mudline.

3.2.8.1 Obstructions

If a pile encounters an underground obstruction within 5 feet of the ground surface of such size as to prevent driving the pile to the required driving criteria and the obstruction cannot be cleared by excavation then the pile must be pulled or cut off at no cost to the Government. If such an obstruction is encountered more than 5 feet below the ground surface and the obstruction cannot be cleared by their drilling or spudding, the pile must be cut off and paid for as if a completed pile. In either event, a replacement pile must be installed at a location indicated by the Contracting Officer and paid for as a completed pile.

3.2.8.2 Splicing Piles

Make splices as indicated. Splices must be capable of developing the full strength of the member in compression, tension, shear, and bending.

3.2.9 Jetting of Piles

Water jets will not be permitted to aid the installation of piling. If necessary, internal jetting may be used to aid the pulling of piles.

3.2.10 Predrilling of Piles

Predrilling to remove soil or other material representing the bulk of the volume of the pile to be driven will be permitted. The diameter of the hole must not exceed two-thirds the width of the pile. Discontinue

drilling when the pile tip is approximately 10 feet above the indicated pile tip elevation. Drive pile the final 10 feet of penetration or more using an impact hammer to meet the required driving criteria.

3.2.10.1 Heaved Piles

When driving piles in clusters or under conditions of relatively close spacing, perform observations to detect heave of adjacent piles. Backdrive heaved piles to original to the required minimum tip elevation and driving resistance as directed by the Contractor's Geotechnical Consultant, after reviewing the heave data, without additional cost to the Government.

3.2.10.2 Pulled Piles

Pull and replace piles damaged or impaired for use during driving with new piles, or cut off and abandon and drive new piles as directed without additional cost to the Government. The Contracting Officer may require that any pile be pulled for inspection. Redrive piles pulled as directed and found to be in suitable condition at another location as directed. Replace piles pulled as directed and found to be damaged with new piles at the Contractor's expense. Piles which cannot be pulled must be cutoff per Paragraph entitled "Rejected Piles".

3.2.10.3 Long Piles

Provide pile driving rig with rigid supports so that leads remain accurately aligned. Where a high degree of accuracy is required, erect templates or guide frames at or close to the ground or water surface.

3.2.10.4 Welding

AWS D1.1/D1.1M. Welding of splices must conform to the requirements of Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Shop and field welding, qualification of welding procedures, welders, and welding operators must be in accordance with AWS D1.1/D1.1M.

3.2.11 Concrete Infill

Mix and place concrete infill in accordance with Section 03 31 30 MARINE CONCRETE. Concrete shall be placed to the elevations indicated.

3.3 FIELD QUALITY CONTROL

3.3.1 Test Piles

Use test piles of type, and drive as specified for piling elsewhere in this section. The Contractor's Geotechnical Consultant will use test pile data to determine "calculated" pile tip elevation or necessary driving criteria. Drive test piles at the locations indicated. Drive test piles to indicated tip elevation for king piles, or required driving criteria for bearing piles. Use test piles, if located properly and offering adequate driving resistance in finished work. Provide and operate a pile driving analyzer as specified in paragraph DYNAMIC PILE ANALYSIS during the driving of each test pile. Modify driving as required based upon recommendation of Contractor's Geotechnical Consultant and approval of the Contracting Officer.

3.3.1.1 Dynamic Pile Analysis

Dynamic testing provides supplemental information for evaluating pile integrity, hammer and drive system performance, assess pile installation driving stresses, and pile capacities. Perform dynamic testing on indicated test piles during the full length of the pile driving and during restrike a minimum of 24 hours after initial driving (restrike testing is required only for piles that did not achieve the required capacity during initial driving). Provide equipment to obtain dynamic measurements, record, reduce and display its data that meet the requirements of ASTM D4945. The equipment must have been calibrated within 6 months prior to the start of the testing operations and thereafter throughout the contract duration. Drive test piles at the locations indicated. Employ an independent inspection firm, hereinafter referred to as the "Contractor's Geotechnical Consultant", experienced in the pile driving process, monitoring of test pile installation, and in the use of the Pile Driving Analyzer and its related equipment. Submit a performance report summarizing dynamic test results for test piles within 7 calendar days of completing field work. Perform dynamic pile analysis as follows:

3.3.1.2 Pile Analyzing

21 working days prior to driving the test piles, submit the pile and complete driving equipment data to the Contracting Officer. The Contractor's Geotechnical Consultant must use the submitted information to perform wave equation analyses and must prepare a summary report of the wave equation results. The wave equation analysis using GRLWEAP software by Pile Dynamics, Inc. or equivalent must be used to assess the ability of the proposed driving system to install the pile to the required capacity and desired penetration depth within the allowable driving stresses. Approval of the proposed driving system by the Contracting Officer must be based upon the wave equation analyses indicating that the proposed driving system can develop the indicated pile capacity within allowable driving stress limits. The hammer must also be sized or adjustable such that the penetration per blow at the required ultimate capacity does not exceed 10 blows per inch.

3.3.1.3 Pile Drivability

Perform each dynamic pile analysis in two steps. The first step is to check the hammer, pile and soil performance, and to determine the suitability of the proposed hammer for the size, length and type of pile being installed for the soil types encountered as the piles are driven. This initial monitoring must determine whether pre-augering is appropriate, efficiency of the hammer relative to specified efficiency, effectiveness of cushion, level of compressive and tensile stress in pile and extent/location of any pile damage caused by the initial driving. With each blow of the pile, record the information listed below electronically and analyze the information using the Pile Driving Analyzer:

- a. Blow number
- b. Blow rate per minute and stroke.
- c. Input and reflected values of force and velocity.
- d. Value of upward and downward traveling force wave with time.
- e. Maximum and final transferred energy to pile, hammer system efficiency.

- f. Maximum compressive stress, velocity, acceleration and displacement.
- g. Maximum tensile stress in pile.
- h. Pile structural integrity, damage detection, extent and location.
- i. Bearing capacity of pile by Case method.

If the pile, hammer and soil performance evaluation recommends changes to the hammer stroke, pile cushioning, augering or any other aspect for the pile driving operation, incorporate these changes into production pile driving in an effort to control excessive stresses and pile damage. Replace test piles damaged or broken during installation, incorporating driving modifications as determined by the Contractor's Geotechnical Consultant and reviewed and approved by the Contracting Officer. Repeat this procedure until allowable tensile and compressive stresses are achieved in the pile and pile damage is minimized. Subject selected initial driving records to rigorous computer analysis by the Case Pile Wave Analysis Program (CAPWAP) for determination of resistance distribution, soil resistance and properties, and estimation of anticipated gain/loss factors.

3.3.1.4 CAPWAP

Signal matching analysis by CAPWAP software of the dynamic pile testing data must be performed on data obtained from the end of initial driving and the beginning of restrrike of all control piles. CAPWAP analyses must be performed by an engineer who has achieved Advanced Level or better on the PDI / PDCA Dynamic Measurement and Analysis Proficiency Test for Providers of PDA Testing Services.

Upon completion of test pile driving, allow the piles to set-up for at least 24 hours. After evaluation of pile, hammer and soil performance by the Contractor's Geotechnical Consultant, the second step of the dynamic pile analysis may proceed. This portion of the evaluation requires striking the set-up piles a minimum of 20-50 times, or as directed by the Contractor's Geotechnical Consultant using the same hammer which was used for the test pile driving and which will be used for production pile driving. "Warm up" the hammer and make it optimally ready prior to restriking, in order to avoid capacity losses during evaluation of restrrike data. Apply maximum hammer energy during restrrike in order to fully mobilize the soil resistance. However, exercise care so as to not overstress the pile. In addition to those items listed above, selected restrrike driving records (as directed by the Contractor's Geotechnical Consultant are to be subjected to rigorous computer analysis by the Case Pile Wave Analysis Program (CAPWAP) for determination of resistance distribution, soil resistance and properties, and plot of applied load vs. average pile displacement based on the calculated soil properties.

3.3.1.5 Dynamic Load Test Reporting

- a. Upon satisfactory completion of each dynamic load test, submit a Pile Performance Report for the Contractor by the Contractor's Geotechnical Consultant. The submittal must be prepared and sealed by a Professional Engineer registered in Rhode Island.
- b. The report for the Dynamic Pile Analysis must contain the following information:

- (1) Capacity of pile from Case Pile Wave Analysis Program (CAPWAP). Information resulting from analysis of a selected restrike blow.
 - (2) Maximum and final transferred energy, hammer system efficiency during pile installation.
 - (3) Maximum compressive stress, velocity, acceleration and displacement.
 - (4) Maximum tensile stress in pile.
 - (5) Pile structural integrity, damage detection, extent and location.
 - (6) Blows per minute and blow number.
 - (7) Input and reflection values of force and velocity, upward and downward traveling force wave with time.
 - (8) Pile skin friction and toe resistance distribution.
 - (9) Maximum energy transferred to pile.
- c. The maximum allowable pile design load must be proposed by the Contractor's Geotechnical Consultant based upon the results of a satisfactory pile load test conducted on a pile driven as specified herein and must include the effects of load transfer to the soil above the foundation stratum.

Use either a Model 8G or PAX Pile Driving Analyzer as manufactured by Pile Dynamics, Inc., of Cleveland Ohio or approved equivalent, for dynamic testing of the pile hammer and for dynamic load testing of the test pile. All equipment necessary for the dynamic monitoring such as sensors, cables or wireless transmitters, must be furnished by the Contractor's Geotechnical Consultant. The equipment must conform to the requirements of ASTM D4945.

Pay for all services of the Contractor's Geotechnical Consultant. The Contractor's Geotechnical Consultant must be available throughout the pile driving operation to consult with the Contracting Officer when required by the Contracting Officer. The cost of changes in the Contractor's procedure, as required by evaluation of the results of the Pile Driving Analysis, will be at the Contractor's expense.

3.3.2 Pile Records

Keep a complete and accurate record of each pile driven. Indicate the pile location, deviations from pile location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut-off elevations, number of blows required for each foot of penetration and number of blows for the last 6 inches penetration or fraction thereof for the "calculated" driving resistance. Include in the record the beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used. Record retap data and unusual occurrences during pile driving such as redriving, heaving, weaving, splicing, obstructions, and any driving interruptions. Submit to the Contracting Officer complete and accurate test and production pile driving

records within 15 calendar days after completion of driving. Make pile driving records available to the Contracting Officer at the job site, within 24 hours after each day of pile driving. A preprinted pile driving log for recording pile driving data and pile driving equipment data form, which can be downloaded at:

<https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>.

3.3.3 Testing Agency Qualifications

Engage an independent testing agency or the Contractor's Geotechnical Consultant to observe the production piles installation. The testing agency must be qualified according to ASTM E329 for testing indicated. Submit testing agency qualifications to the Contracting Officer for approval.

3.3.4 Welding Inspection

Employ a testing agency to perform the welding inspections as specified in the statement of special inspection.

3.3.5 Weld Testing

In addition to visual inspection, welds must be tested and inspected according to SECTION 05 50 14 STRUCTURAL METAL FABRICATIONS, AWS D1.1/D1.1M and inspection procedures listed below, at testing agency's option. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents. Test 100 percent of pile splices.

- a. Liquid Penetrant Inspection: ASTM E165/E165M.
- b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
- c. Radiographic Inspection: ASTM E94/E94M, minimum quality level "2-2T."
- d. Ultrasonic Inspection: ASTM E164.

3.3.6 Concrete Infill

Perform field quality control testing of the concrete infill in accordance with Section 03 31 30 MARINE CONCRETE.

3.4 TOUCHUP PAINTING

Clean field welds, splices, and abraded painted areas and field-apply paint according to Section 09 97 13.26 COATING OF STEEL WATERFRONT STRUCTURES. Use same paint and apply same number of coats as specified. Apply touchup paint before driving piles to surfaces that are immersed or inaccessible after driving. Underwater coating repair must be an approved diver installed petrolatum tape system, with a minimum of 6 inches of overlap above and below the damaged coating area.

-- End of Section --

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SECTION 31 62 16.16

STEEL H-PILES

11/20

PART 1 GENERAL

1.1 DESCRIPTION

Design, furnish, install and test piles at the locations indicated on the drawings and specified herein. Assume test piles will be directed to be placed in a locations that can be incorporated into the work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020; Errata 1 2021) Structural Welding
Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A572/A572M (2021; E 2021) Standard Specification for
High-Strength Low-Alloy Columbium-Vanadium
Structural Steel

ASTM D4945 (2017) Standard Test Method for
High-Strain Dynamic Testing of Deep
Foundations

ASTM E94/E94M (2017) Standard Guide for Radiographic
Examination Using Industrial Radiographic
Film

ASTM E164 (2019) Standard Practice for Contact
Ultrasonic Testing of Weldments

ASTM E165/E165M (2018) Standard Practice for Liquid
Penetrant Examination for General Industry

ASTM E329 (2021) Standard Specification for Agencies
Engaged in Construction Inspection,
Testing, or Special Inspection

ASTM E709 (2021) Standard Guide for Magnetic
Particle Testing

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1 (2016) Shop, Field, and Maintenance
Coating of Metals

1.3 SUBSURFACE DATA

Subsurface soil data logs are provided on the project drawings. These samples are being retained by the Navy. The location is transient, but can be made available.

1.4 BASIS OF BID

1.4.1 Production Pile Acceptance Criteria

Safe design capacity for piles is indicated kips. Drive piles to a minimum depth of 25 feet below cut-off elevation, and to such additional depth as required to obtain indicated design capacity. The Contractor's Geotechnical Consultant will determine the terminal driving criteria based on results of dynamic pile driving tests at end of drive or restrrike.

1.4.2 Basis for Bid

For unit price bid, see Price Schedule.

Requirements of FAR 52.211-18 Variation in Estimated Quantity do not apply to payment for piling. Each pile and test pile acceptably provided will be paid for at the bid unit price per unit length, which will include items incidental to furnishing and driving the piles including mobilization and demobilization, predrilling probing, redriving uplifted piles, an additional 5 feet in furnished length for any test pile not driven beyond estimated pile length, and cutting off piles at the cut-off elevation. Include the cost for additional length for the test piles in the total unit price cost for the job. Payment will be made for production and test piles at the bid unit price for the length of pile, from tip to final cut-off, actually provided, excluding splices directed by the Contracting Officer to be made. If the actual cumulative pile length driven (tip to cut-off) vary more than 25 percent from the total pile length specified as a basis for bidding, at the direction of the Contracting Officer, the unit price per unit length will be adjusted in accordance with provisions of FAR 52.236-2 Differing Site Conditions..

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installation Procedures; G

Contractor's Geotechnical Consultant; G

Testing Agency Qualification; G

Wave Equation Analysis; G

SD-02 Shop Drawings

Pile splices; G

Pile placement; G

Pile Reinforcing Tips or Pile Points

SD-03 Product Data

Pile Driving Equipment; G

Pile Driving Records; G

Delivery, Storage, and Handling; G

SD-05 Design Data

Wave Equation Analysis

Quantities List; G

Procedure for Insufficient Pile Length; G

SD-06 Test Reports

Test Pile; G

Load Test; G

Dynamic Pile Analysis; G

Pile Performance Report

SD-07 Certificates

Pile Material Certificates of Compliance; G

Pile Splices; G

Pile Shoes; G

SD-11 Closeout Submittals

Pile Driving Records

1.6 DELIVERY, STORAGE, AND HANDLING

Conform all delivery, storage, and handling of materials to the requirements specified herein. Develop and submit plans for the delivery, storage, and handling of piles. Submit delivery, storage, and handling plans for piles at least 30 calendar days prior to delivery of piles to the job site.

1.6.1 Delivery and Storage

Stack piles during delivery and storage so that each pile is maintained in a straight position and is supported every 10 feet or less along its length (ends inclusive) to prevent exceeding the maximum camber or sweep. Do not stack piles more than 5 feet high.

1.6.2 Handling

Lift piles using a cradle or multiple points pick-up to ensure that the maximum permissible camber or sweep is not exceeded due to insufficient support for lifting piles that are not extremely long into the driving leads. One pick up point can be used for short piles. Point pick-up devices must be of the type that clamp to both pile flanges at each pick-up point. Holes may be burned in the flanges or webs of piles above the cutoff length for lifting piles into the leads. Do not damage piles when dragging piles across the ground.

1.6.3 Excessive Camber, Sweep, and Damage

Inspect piles for excessive camber and sweep and for damage before transporting them from the storage area to the driving area and immediately prior to placement in the driving leads. Camber, curvature in the pile in the direction normal to the pile flanges, must be measured with the pile flange base laying on a flat surface and is the distance between the flange base at the mid-length of the pile and the flat surface. Sweep, curvature in the pile in the direction parallel to the pile flanges, must be measured with the pile flange tips laying on a flat surface and is the distance between the flange tips at the mid-length of the pile and the flat surface. The maximum permissible camber and or sweep is 2 inches over the length of the pile. Piles having excessive camber or sweep will be rejected.

1.6.4 Damaged Piles

Inspect each pile for straightness and structural damage before transporting them to the project site and immediately prior to placement in the driving leads. Bring any damage to the attention of the Contracting Officer. Piles which are damaged during delivery, storage, or handling to the extent they are rendered unsuitable for the work, in the opinion of the Contracting Officer, will be rejected and removed from the project site, or may be repaired, if approved, at no cost to the Government.

Any pile damaged by reason of internal defects or by improper driving must be corrected by one of the following methods approved by the Engineer for the pile in question:

- a. The pile is withdrawn, if practicable, and replaced by a new and, if necessary, longer pile.
- b. One or more replacement piles are driven adjacent to the defective pile.
- c. A Pile Dynamic Analysis and low integrity testing must be performed by the Contractor's Geotechnical Consultant to assess the structural integrity of the driven pile(s).

1.6.5 Pile Butt Location and Elevation

A pile driven below the specified butt elevation must be corrected by one of the following methods approved by the Engineer:

- a. One or more replacement piles are driven next to the pile in question.
- b. As directed by the structural engineer.

A pile driven out of its proper location or out of plumb as approved by the Engineer, must be corrected by one of the following methods approved by the engineer:

- a. One or more replacement piles are driven next to the pile in question.
- b. As directed by the structural engineer.

1.6.6 Pile Sweep

Limit sweep to 1/8 inch per 10 feet over the length of the pile. Piles having excessive sweep will be rejected.

1.7 QUALITY CONTROL

1.7.1 Piles

Prepare and submit shop drawings. Indicate placement of piles. Indicate location of special embedded or attached lifting devices, employment of pick-up points, support points other than pick-up points, and any other methods of pick-up.

1.7.2 Contractor's Geotechnical Consultant

Hire the services of an independent, Registered Professional Geotechnical Engineer, experienced in soil mechanics and Pile Dynamic Analysis, to observe test pile installation and production pile installation as specified herein. The Contractor's Geotechnical Consultant must be independent of the Contractor and must have no employee or employer relationship which could constitute a conflict of interest. Submit Contractor's geotechnical consultant qualifications at least 30 calendar days before pile installation.

Provide instructions and procedures on how the Contractor will assist the Government in the processes of Dynamic Pile Testing, Inspection and Monitoring of piles during installation and testing.

1.7.3 Pile Manufacturer's Quality Control Procedures

Submit the pile manufacturer's quality control procedures.

1.7.4 Installation Procedures

- a. Submit information on the type of equipment proposed to be used, proposed methods of operation, pile driving plan including proposed sequence of driving, and details of all pile driving equipment and accessories. Submit pile driving equipment information at least 30 calendar days prior to commencement of work.
- b. Provide details of pile driving equipment and a Wave Equation Analysis of pile drivability for selection of the hammer along with a statement of driving procedures. Submit wave equation analysis for each pile location. The Wave Equation Analysis is to be completed by the Contractor's Geotechnical Consultant for each test pile location where different subsurface conditions exist and is to include the following information pertaining to the proposed pile driving equipment:

(1) Complete Pile and Driving Equipment Data Form, (which can be

downloaded at: <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>) for each proposed pile hammer and pile type combination.

- (2) Copies of computer input and output sheets and graphs showing soil resistance versus blow count as well as maximum tension and compression stresses versus blow count. Analysis must be run at the estimated tip elevation as well as other required elevations to define maximum stress levels in the pile during driving.
- c. Provide detailed procedures for conducting the dynamic pile load test and equipment to be used for conducting the load test. The detailed description must explain how specific information of pile performance will be evaluated.

PART 2 PRODUCTS

2.1 PILE REQUIREMENTS

Order test piles 5 feet longer in length than production piles. Drive the additional test pile length only when based upon the recommendation of the Contractor's Geotechnical Consultant and approved by the Contracting Officer. Submit test pile and load test reports. The Contractor's Geotechnical Consultant will use test pile data to determine "calculated" pile tip elevation and necessary driving resistance. This information will be given to the Contractor no later than 7 days from receipt of complete test data. Use this list as the basis for ordering the piles. Do not order piles until list is provided by the Contractor's Geotechnical Consultant.

2.2 MATERIALS

2.2.1 H-Piles

ASTM A572/A572M, Grade 50. Provide test piles identical to those used elsewhere in the project. Provide square and blunt pile tips, as received from the mill. Steel H-Piles shall be furnished with a reinforced driving shoe designed to engage rock, welded continuously around the tip of the pile or as specified by the manufacturer. Provide H-piles of the shape and sections shown. Submit pile material certificates of compliance certifying that materials meet the requirements specified herein. Determine lengths of piles as specified in paragraph "Installation," subparagraph "Lengths of Production Piles" and paragraph "Pile Tests," subparagraph "Test Piles". Submit pile dynamic test plan at least 30 days prior to installing any test piles. Approval of the plan does not relieve the Contractor of the responsibility for structural and operational adequacies of the testing system.

2.2.2 Pile Splices

ASTM A572/A572M, Grade 50 for splice plates. Submit detail drawings of pile splices prior to fabrication. Submit Pile Splice Welder Qualifications.

2.2.3 Pile Points

ASTM A572/A572M, Grade 50 for pile tip reinforcements. Pile points must shown be provided on all piles.

2.2.4 Pile Caps

ASTM A572/A572M, Grade 50. Pile caps must conform to details shown.

2.2.5 Fabrication

Fabrication must conform to the requirements shown and as specified herein and in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

2.2.5.1 Pile Splices

Fabricate pile splices as shown. Submit detail drawings of splices in accordance with paragraph SUBMITTALS. Perform all welding in accordance with the requirements for shield metal arc welding of AWS D1.1/D1.1M. Submit welding procedure for shop splices and verification of welder qualifications. Make no more than one field splice per 80 feet of pile, unless directed by the Contracting Officer. Fabrication drawings must show all shop splices. Contractor shall coordinate pile lengths so as to avoid making splices within 20 feet of the bottom of pile cap.

2.2.5.2 Pile Shoes

Attach pile shoes as shown. Submit Certificates of compliance certifying that materials meet the requirements specified herein.

2.3 PILE DRIVING EQUIPMENT

Select the proposed pile driving equipment, including hammers and other required items, and submit complete descriptions of the proposed equipment in accordance with paragraph SUBMITTALS. Final approval of the proposed equipment is subject to the satisfactory completion and approval of pile tests. Changes in the selected pile driving equipment will not be allowed after the equipment has been approved except as directed. No additional contract time will be allowed for Contractor proposed changes in the equipment.

2.3.1 Pile Driving Hammers

Provide impact or vibratory type pile driving hammers.

2.3.1.1 Impact Hammers

Provide air, hydraulic or diesel-powered impact pile hammers of the single-acting, double-acting, or differential-acting type. The size or capacity of hammers must be in accordance with the results of Wave Equation analyses. Provide boiler, compressor, or engine capacity sufficient to operate hammers continuously at the full rated speed. Hammers must have a gage to monitor hammer bounce chamber pressure for diesel hammers or pressure at the hammer for air hammers. This gage must be operational during the driving of piles and be mounted in an accessible location for monitoring by the Contractor and the Contracting Officer. Provide bounce chamber pressure gage correction tables and charts for the type and length of hose to be used with the pressure gage to the Contracting Officer. Hydraulic hammers must be equipped with a system for measurement of ram energy. The system must be in good working order and the results must be easily and immediately available to the Engineer. Install an energy monitor on the hydraulic hammers and record readings every 12 inches of pile installation. Use wave equation analysis to verify that the hammer will develop stresses within acceptable limits in

the piles. Position a pile cap or drive cap between the pile and hammer. Place hammer cushion or cap block between ram and the pile cap or drive cap. Hammer cushion or cap block must have consistent elastic properties, minimize energy absorption, and transmit hammer energy uniformly and consistently during the entire driving period. In accordance with paragraph SUBMITTALS, submit the following information for each impact hammer proposed:

- a. Make and model.
- b. Ram weight (pounds).
- c. Anvil weight (pounds).
- d. Rated stroke (inches).
- e. Rated energy range (foot-pounds).
- f. Rated speed (blows per minute).
- g. Air pressure, hammer, and boiler and or compressor(psi).
- h. Rated bounce chamber pressure curves or charts, including pressure correction chart for type and length of hose used with pressure gage (pounds per square inch).
- i. Pile driving cap, make, and weight (pounds).
- j. Cushion block dimensions and material type.
- k. Power pack description.

2.3.2 Pile Driving Leads

Support and guide hammers with fixed extended leads or fixed underhung leads. Provide two intermediate supports for the pile in the leads to reduce the unbraced length of the pile during driving and pulling.

2.3.3 Pile Extractors

Pile extractors may be vibratory or impact pile driving hammers. Impact hammers are required for pulling piles not extractable with vibratory hammers.

PART 3 EXECUTION

3.1 PRELIMINARY WORK

3.1.1 Wave Equation Analysis of Pile Drivability

- a. Prior to driving any pile, submit a pile Wave Equation Analysis, performed by Contractor's Geotechnical Consultant, for each size pile and distinct subsurface profile condition. These analyses must take into account the proposed hammer assembly, pile cap block and cushion characteristics, the pile properties and estimated lengths and the soil properties anticipated to be encountered throughout the installed pile length based on static capacity analysis with consideration of driving gain/loss factors. Only one specific model of pile hammer may be used for each pile type and capacity. Provide instructions and

procedures on how the Contractor will perform Dynamic Pile Testing, Inspection and Monitoring of piles during installation and testing.

- b. Demonstrate using the Wave Equation Analysis that the piles will not be damaged during driving, indicate that the driving stresses will be maintained within the limits below and indicate the blow count necessary to achieve the required ultimate static pile capacities.

Allowable Driving Stresses

Steel Piles

Compression - 0.9 fy
Tension - 0.9 fy

Where fy is yield strength of steel

- c. Perform a refined Wave Equation Analysis with signal matching (CAPWAP) upon completion of the dynamic and static testing programs outlined in this specification section, taking into consideration the evaluated capacities, gain/loss factors and recommended production pile lengths. Develop production pile driving criteria based on the results of the refined Wave Equation Evaluations, considering re-strike data.
- d. All pile driving equipment provided by the Contractor will be subject to the approval of the Contractor's Geotechnical Consultant. Complete the attached pile and driving equipment data form, including hammer information, in full as part of the submittal of the results of the Wave Equation Analyses.
- e. Pay for the cost of performing the Wave Equation Analyses and include in the base bid.

3.1.2 Order List

Submit to the Contracting Officer for approval, an itemized quantities list for piles prior to placing the order with the supplier. Indicate the pile lengths required at each location as shown on the plans and the corresponding ordered length of each pile in the list. Complete dynamic load testing and refined wave equation analysis and submit to Government for review and approval prior to submission of an order list.

3.2 INSTALLATION

Inspect piles when delivered and when in the leads immediately before driving. Cut piles at cutoff grade by an approved method. Where cutoff is below existing ground or mudline elevation, complete excavation, sheeting, and dewatering before driving pile to cutoff elevation.

3.2.1 Lengths of Production Piles

The estimated quantities of piles are given for bidding purposes only. Drive piles to or below "calculated" indicated tip elevation to reach a driving resistance established by the wave equation analyses (WEAP) in accordance with the schedule which the Contractor's Geotechnical Consultant will prepare from the test-pile driving data.

3.2.2 Pile Driving Records

Submit the proposed form for compiling pile driving records 30 calendar days prior to commencement of work.

Contractor's Geotechnical Engineer must keep a complete and accurate record of each pile driven. Indicate the pile location, deviations from pile location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut-off elevations, number of blows required for each foot of penetration and number of blows for the last 6 inches penetration or fraction thereof as required for the "calculated" driving resistance. Include in the record the beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used. Record retap data and unusual occurrences during pile driving such as redriving, heaving, weaving, splicing, obstructions, and any driving interruptions. A preprinted pile driving log for recording pile driving data and pile driving equipment data form, which can be downloaded at: <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>

Submit to the Contracting Officer complete and accurate test and job pile driving records as specified in paragraph RECORDS of this section, within 15 calendar days after completion of driving. Make pile driving records available to the Contracting Officer at the job site, within 24 hours after each day of pile driving.

3.2.3 Pile Placement and Tolerances in Driving

Develop and submit a pile placement plan which shows the installation sequence and the methods proposed for controlling the location and alignment of piles. Submit pile placement plan at least 30 calendar days prior to delivery of piles to the job site. Complete all foundation preparation in the area prior to the placement of piles for driving. Accurately place piles in the correct location and alignments, both laterally and longitudinally, and to the vertical or batter lines indicated. Establish a permanent base line to provide for inspection of pile placement by the Contracting Officer during pile driving operations prior to driving production piles and maintain during the installation of the production piles.

A final lateral deviation from the correct location at the cutoff elevation of not more than 3 inches will be permitted for vertical and battered piles. Manipulation of piles will not be permitted. A variation of not more than 0.25 inch per foot of pile length from the vertical for vertical piles nor more than 0.50 inch per foot of pile length from the required angle for batter piles will be permitted. In addition to complying with the tolerances stated herein, the clear distance between the heads of piles and the edges of caps must be not less than 6 inches. Redesign of pile caps or additional work required due to improper location of piles is the responsibility of the Contractor. A vertical deviation of not more than one inch from the correct cutoff elevations shown is permitted. Inspect piles for heave. Redrive heaved piles to the required pile driving criteria. Maintain the correct relative position of all piles by the use of templates or by other approved means. Piles damaged or not located properly or exceeding the maximum limits for lateral and vertical deviation, or variation in alignment must be pulled and new piles redriven, or provide additional piles, at a location directed at no

additional cost to the Government.

3.2.3.1 Survey Data

After the driving of each pile group is complete, provide the Contracting Officer with an as-driven survey showing actual location and top elevation of each pile. Do not proceed until the Contracting Officer has reviewed the survey and verified the piles have been installed per these specifications. Present a survey in such form that it gives deviation from plan location in two perpendicular directions and elevations of each pile to nearest half inch. Survey must be prepared and certified by a land surveyor licensed in Rhode Island.

3.2.4 Pile Penetration Criteria

The controlling driving resistance for production piles will be determined by the Contractor's Geotechnical Consultant. The required initial driving criteria and restrrike will be established subsequent to the analysis of pile tests as specified in paragraph PILE TESTS.

3.2.5 Pile Length Markings

Mark each pile prior to driving with horizontal lines at one foot intervals. Mark each pile every inch within the last 5 feet of anticipated tip penetration. Mark the inch interval number on pile every 5 feet from pile tip.

3.2.6 Pile Driving

Notify Contracting Officer 10 calendar days prior to driving of test piles. Stop foundation excavation at one foot above foundation grade before piles are driven. Do not drive piles within 100 feet of concrete less than 7 days old. Complete excavation to lines and grades shown when pile driving is completed. The Contractor's Geotechnical Consultant will determine the terminal driving criteria based on results of dynamic pile driving tests at the end of drive or restrrike. Drive piles to the terminal driving criteria or below "calculated" to reach a driving resistance established by the dynamic pile driving tests at the end of drive or restrrike in accordance with the schedule which the Contractor's Geotechnical Consultant will prepare from the test-pile driving data. During initial driving and until pile tip has penetrated beyond layers of very soft soil, use a reduced driving energy of the hammer as required to prevent pile damage. Refusal criteria will be established by the Contracting Officer. If a pile fails to reach "calculated" tip elevation, or if a pile reaches "calculated" tip elevation without reaching required driving resistance, notify Contracting Officer and perform corrective measures as directed. Provide hearing protection when noise levels exceed 140 dB. Piles may be driven without pile guides or leads providing a hammer guide frame is used to keep the pile and hammer in alignment.

3.2.7 Protection of Piles

Take care to avoid damage to piles during handling, placing pile in leads, and during pile driving operations. Support piles laterally during driving, but allow rotation in leads. Maintain axial alignment of pile hammer with that of the pile. If the Contractor elects to use a pile head with projecting strands or mild steel reinforcement, prevent direct impact forces from being transmitted through the reinforcement, by using a special driving head.

3.2.8 Rejected Piles

Withdraw piles damaged or impaired for use during handling or driving, mislocated, or driven out of alignment beyond the maximum tolerance. Replace with new piles or cut-off and abandon damaged or impaired piles and drive new piles as directed. Remove excess cut-off from piles and unacceptable piles from the work site. Perform all work in connection with withdrawing and removing rejected piles from the site at no additional cost to the Government.

3.2.8.1 Obstructions

If a pile encounters an underground obstruction within 5 feet of the ground surface of such size as to prevent driving the pile to the required driving criteria, the pile must be pulled or cut off at no cost to the Government. If such an obstruction is encountered more than 5 feet below the ground surface, the pile must be cut off and paid for as if a completed pile. In either event, a replacement pile must be installed at a location indicated by the Contracting Officer and paid for as a completed pile.

3.2.8.2 Splicing Piles

Splices must be capable of developing the full strength of the member in compression, tension, shear, and bending. Submit detail drawings of splices and design calculations demonstrating the strength of the splice for approval. Provide a detailed procedure for insufficient pile length where recovering of pile length is required.

3.2.9 Jetting of Piles

Water jets will not be permitted.

3.2.10 Predrilling of Piles

Predrilling to remove soil or other material representing the bulk of the volume of the pile to be driven will not be permitted.

3.2.10.1 Heaved Piles

When driving piles in clusters or under conditions of relatively close spacing, perform observations to detect heave of adjacent piles. Backdrive heaved piles to original to the required depth of penetration as directed by the Contractor's Geotechnical Consultant, after reviewing the heave data, without additional cost to the Government.

3.2.10.2 Pulled Piles

Pull and replace piles damaged or impaired for use during driving with new piles, or cut off and abandon and drive new piles as directed without additional cost to the Government. The Contracting Officer may require that any pile be pulled for inspection. Redrive piles pulled as directed and found to be in suitable condition at another location as directed. Replace piles pulled as directed and found to be damaged with new piles at the Contractor's expense.

3.2.10.3 Long Piles

Provide pile driving rig with rigid supports so that leads remain accurately aligned. Where a high degree of accuracy is required, erect templates or guide frames at or close to the ground or water surface.

3.2.10.4 Welding

AWS D1.1/D1.1M. Welding of splices must conform to the requirements of Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Shop and field welding, qualification of welding procedures, welders, and welding operators must be in accordance with AWS D1.1/D1.1M.

3.3 FIELD QUALITY CONTROL

3.3.1 Test Piles

Order test piles 10 feet longer in length than production piles. Drive the additional test pile length only at the direction of the Contracting Officer. The Contractor's Geotechnical Consultant will use test pile data to determine "calculated" pile tip elevation or necessary driving criteria. Drive test piles in vicinity of soil boring test holes Nos. LB-27, LB-28, and LB-29. Drive test piles to required driving criteria. Use test piles, if located properly and offering adequate driving resistance in finished work. Provide and operate a pile driving analyzer as specified in paragraph DYNAMIC PILE ANALYSIS during the driving of each test pile. Modify driving as required based upon recommendation of Contractor's Geotechnical Consultant and approval of the Contracting Officer.

3.3.1.1 Dynamic Pile Analysis

Submit a performance report summarizing dynamic test results for test piles within 7 calendar days of completing field work. For production piles, submit a performance report within one day of testing. Submit a typed report summarizing the results of dynamic testing of production piles on a monthly basis.

Dynamic testing provides supplemental information for evaluating pile integrity, hammer and drive system performance, assess pile installation driving stresses, and pile capacities. Perform dynamic testing on 10 percent of the piles during the full length of the pile driving and during restrike a minimum of 7 days after initial driving. Restrike testing is required only for piles that did not achieve the required capacity during initial driving. Provide equipment to obtain dynamic measurements, record, reduce and display its data that meet the requirements of ASTM D4945. The equipment must have been calibrated within 6 months prior to the start of the testing operations and thereafter throughout the contract duration. Employ an independent inspection firm, hereinafter referred to as the "Contractor's Geotechnical Consultant", experienced in the pile driving process and in the use of the Pile Driving Analyzer and its related equipment. Perform dynamic pile analysis as follows:

3.3.1.2 Pile Analyzing

21 working days prior to driving the test piles, submit the pile and complete driving equipment data to the Contracting Officer. The Contractor's Geotechnical Consultant must use the submitted information to perform wave equation analyses and must prepare a summary report of the

wave equation results. The wave equation analysis using GRLWEAP software by Pile Dynamics, Inc. or equivalent must be used to assess the ability of the proposed driving system to install the pile to the required capacity and desired penetration depth within the allowable driving stresses. Approval of the proposed driving system by the Contracting Officer must be based upon the wave equation analyses indicating that the proposed driving system can develop a pile capacity as indicated at a driving resistance not greater than 15 blows per inch within allowable driving stress limits. The hammer must also be sized or adjustable such that the penetration per blow at the required ultimate capacity does not exceed 0.5 inches.

3.3.1.3 Pile Drivability

Perform each dynamic pile analysis in two steps. The first step is to check the hammer, pile and soil performance, and to determine the suitability of the proposed hammer for the size, length and type of pile being installed for the soil types encountered as the piles are driven. This initial monitoring must determine whether pre-augering or jetting is appropriate, efficiency of the hammer relative to specified efficiency, effectiveness of cushion, level of compressive and tensile stress in pile and extent/location of any pile damage caused by the initial driving. With each blow of the pile, record the information listed below electronically and analyze the information using the Pile Driving Analyzer:

- a. Blow number.
- b. Blow rate per minute and stroke.
- c. Input and reflected values of force and velocity.
- d. Value of upward and downward traveling force wave with time.
- e. Maximum and final transferred energy to pile, hammer system efficiency.
- f. Maximum compressive stress, velocity, acceleration and displacement.
- g. Maximum tensile stress in pile.
- h. Pile structural integrity, damage detection, extent and location.
- i. Bearing capacity of pile by Case method.

If the pile, hammer and soil performance evaluation recommends changes to the hammer stroke, pile cushioning, augering or any other aspect for the pile driving operation, incorporate these changes into production pile driving in an effort to control excessive stresses and pile damage. Replace test piles damaged or broken during installation, incorporating driving modifications as determined by the Contractor's Geotechnical Consultant and reviewed and approved by the Contracting Officer. Repeat this procedure until allowable tensile and compressive stresses are achieved in the pile and pile damage is minimized. Subject selected initial driving records to rigorous computer analysis by the Case Pile Wave Analysis Program (CAPWAP) for determination of resistance distribution, soil resistance and properties, and estimation of anticipated gain/loss factors.

3.3.1.4 CAPWAP

Signal matching analysis by CAPWAP software of the dynamic pile testing data must be performed on data obtained from the end of initial driving and the beginning of restrike of all control piles. CAPWAP analyses must be performed by an engineer who has achieved Advanced Level or better on the PDI / PDCA Dynamic Measurement and Analysis Proficiency Test for Providers of PDA Testing Services.

Upon completion of test pile driving, allow the piles to set-up for at least 7 days. After evaluation of pile, hammer and soil performance by the Contractor's Geotechnical Consultant, the second step of the dynamic pile analysis may proceed. This portion of the evaluation requires striking the set-up piles a minimum of 20-50 times, or as directed by the Contractor's Geotechnical Consultant using the same hammer which was used for the test pile driving and which will be used for production pile driving. "Warm up" the hammer and make it optimally ready prior to restriking, in order to avoid capacity losses during evaluation of restrike data. Apply maximum hammer energy during restrike in order to fully mobilize the soil resistance. However, exercise care so as to not overstress the pile. In addition to those items listed above, selected restrike driving records (as directed by the Contractor's Geotechnical Consultant) are to be subjected to rigorous computer analysis by the Case Pile Wave Analysis Program (CAPWAP) for determination of resistance distribution, soil resistance and properties, and plot of applied load vs. average pile displacement based on the calculated soil properties.

3.3.1.5 Dynamic Load Test Reporting

- a. Upon satisfactory completion of each dynamic load test, submit a minimum of three copies of a Pile Performance Report for the Contractor by the Contractor's Geotechnical Consultant. The submittal must be prepared and sealed by a Professional Engineer registered in Rhode Island.
- b. The report for the Dynamic Pile Analysis must contain the following information:
 - (1) Capacity of pile from Case Pile Wave Analysis Program (CAPWAP). Information resulting from analysis of a selected restrike blow.
 - (2) Maximum and final transferred energy, hammer system efficiency during pile installation.
 - (3) Maximum compressive stress, velocity, acceleration and displacement.
 - (4) Maximum tensile stress in pile.
 - (5) Pile structural integrity, damage detection, extent and location.
 - (6) Blows per minute and blow number.
 - (7) Input and reflection values of force and velocity, upward and downward traveling force wave with time.
 - (8) Pile skin friction and toe resistance distribution.
 - (9) Maximum energy transferred to pile.

- c. The maximum allowable pile design load must be proposed by the Contractor's Geotechnical Consultant based upon the results of a satisfactory pile load test conducted on a pile driven as specified herein and must include the effects of load transfer to the soil above the foundation stratum.

Use either a Model 8G or PAX Pile Driving Analyzer as manufactured by Pile Dynamics, Inc., of Cleveland Ohio or approved equivalent, for dynamic testing of the pile hammer and for dynamic load testing of the test pile. All equipment necessary for the dynamic monitoring such as sensors, cables or wireless transmitters, must be furnished by the Contractor's Geotechnical Consultant. The equipment must conform to the requirements of ASTM D4945.

Pay for all services of the Contractor's Geotechnical Consultant. The Contractor's Geotechnical Consultant must be available throughout the pile driving operation to consult with the Contracting Officer when required by the Contracting Officer. The cost of changes in the Contractor's procedure, as required by evaluation of the results of the Pile Driving Analysis, will be at the Contractor's expense.

3.3.2 Pile Records

Keep a complete and accurate record of each pile driven. Indicate the pile location, deviations from pile location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut-off elevations, number of blows required for each foot of penetration and number of blows for the last 6 inches penetration or fraction thereof as required for the "calculated" driving resistance. Include in the record the beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used. Record retap data and unusual occurrences during pile driving such as re-driving, heaving, weaving, splicing, obstructions, and any driving interruptions. Install an energy monitor on the hammers and record readings every 12 inches of pile installation. A preprinted pile driving log for recording pile driving data and pile driving equipment data form, which can be downloaded at:

<https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables>

3.3.3 Testing Agency Qualification

Engage an independent testing agency to observe the production piles installation. The testing agency must be qualified according to ASTM E329 for testing indicated. Submit testing agency qualifications to the Contracting Officer for approval.

3.3.4 Welding Inspection

Employ a testing agency to perform the welding inspections as specified in the statement of special inspection.

3.3.5 Weld Testing

In addition to visual inspection, welds must be tested and inspected according to AWS D1.1/D1.1M and inspection procedures listed below, at

testing agency's option. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents. Test 100 percent of pile splices, the steel pile cap splice connections and the steel pile insert connection.

- a. Liquid Penetrant Inspection: ASTM E165/E165M.
- b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
- c. Radiographic Inspection: ASTM E94/E94M, minimum quality level "2-2T."
- d. Ultrasonic Inspection: ASTM E164.

3.4 TOUCHUP PAINTING

Clean field welds, splices, and abraded painted areas and field-apply paint according to SSPC PA 1. Use same paint and apply same number of coats as specified. Apply touchup paint before driving piles to surfaces that are immersed or inaccessible after driving.

-- End of Section --

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SECTION 31 63 29

DRILLED CONCRETE SHAFTS

11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 214R	(2011) Evaluation of Strength Test Results of Concrete
ACI 301	(2016) Specifications for Structural Concrete
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2020) Guide to Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
ACI 336.1	(2001) Specification for the Construction of Drilled Piers
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
AWS D1.4/D1.4M	(2018) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2019) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2018a) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2021a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39/C39M	(2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM C138/C138M	(2017a) Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2021) Standard Specification for Portland Cement
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C1064/C1064M	(2017) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1611/C1611M	(2021) Standard Test Method for Slump Flow of Self-Consolidating Concrete

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2018) Manual of Standard Practice
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U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA NHI-10-016

(2010) Drilled Shafts: Construction
Procedures and LRFD Design Methods

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.651

Specific Excavation Requirements

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Drilled Shaft Contractor Qualifications

Installation Plan

SD-02 Shop Drawings

Steel Reinforcement; G

SD-05 Design Data

Mix Design Data; G

SD-06 Test Reports

Slump

Compressive Strength; G

Drilled Shaft Installation Logs; G

SD-07 Certificates

Bill of Lading for Ready-Mix Concrete Deliveries

Steel Reinforcement

Welding Certificates

Excavation and Drilling Equipment

1.3 QUALITY ASSURANCE

1.3.1 Drilled Shaft Contractor Qualifications

The Contractor performing the work described in this specification must have installed drilled shafts (rock sockets) of both the diameter and length similar to those indicated on the drawings for a minimum of three years prior to the bid date for the project. Submit both a list containing at least three projects completed in the last three years on which the Contractor installed drilled shafts of a diameter and length similar to those indicated on the drawings, and a signed statement that

the Contractor has inspected both the project site and all the subsurface information made available in the Contract Documents. The list of projects shall contain the names and phone numbers of owner's representatives who can verify the Contractor's participation on those projects.

1.3.2 Installation Plan

At least 30 days prior to constructing the drilled shaft, the Contractor shall submit an installation plan for review. The plan must include, but not be limited to:

- a. Name and experience record of the drilled shaft superintendent in charge of the drilled shaft operation for this project. Name and experience record of the Contractor's drilled shaft Geotechnical Inspector. Drilled shaft construction and testing shall be inspected by the Contractor's Geotechnical Inspector, who shall be a qualified geotechnical engineering inspector, experienced in drilled shaft construction inspection.
- b. Land access needs and requirements.
- c. List of proposed equipment to be used including cranes, drills, augers, baling buckets, final cleaning equipment, desanding equipment, slurry pumps, core sampling equipment, tremies or concrete pumps, casing, etc. Include information on space requirements for installation equipment.
- d. Details of overall construction operation sequence.
- e. Details of shaft excavation methods in soils and glacial deposits, including methods of removing any obstructions, such as cobbles and boulders.
- f. When slurry is required, details on the methods to mix, circulate, and desand slurry.
- g. Details of the methods to clean the shaft excavation.
- h. Details of reinforcement placement including support and centralization methods.
- i. Details of concrete placement including proposed operational procedure for free fall, tremie or pumping methods, describe method to keep concrete workable with admixtures such as retarders or superplasticizers.
- j. Waste stream/spoils management. Describe how soil, sediment, and water will be controlled and disposed.
- k. Approach to Quality Control.

1.3.3 Specialty Contractor Qualifications

Submit Contractor Qualifications for foundation systems, including Crosshole Sonic Testing and Thermal Integrity Profiling.

1.3.4 Welding Qualifications

Provide and maintain qualified procedures and personnel according to AWS D1.1/D1.1M, AWS D1.4/D1.4M, and AWS A5.1/A5.1M. Submit Welding Certificates to the Contracting Officer.

1.4 QUALITY CONTROL

1.4.1 General

Install drilled shaft foundations in accordance with applicable requirements as described by ACI 336.1, and FHWA NHI-10-016.

1.4.2 Inspection Criteria

Design inspection activities to minimize delays while insuring the intent of the Industry Standard Specifications.

1.4.3 Contractor Supervision/Quality Controls

Provide for the supervision and inspection of all phases of drilled shaft construction (Drilled Shaft Installation Logs). Supervision is the Contractor's responsibility. Inspect each drilled shaft for its depth, water removal, cleanup, workmanship, reinforcement, and for all tolerance requirements before any concrete is placed. Submit documentation of quality control inspections at each phase of the drilled shaft construction.

1.4.4 Government Inspection

The Contracting Officer or designated inspector will inspect each drilled shaft excavation. Do not place concrete until the excavation has been approved by the Contracting Officer. Furnish the Contracting Officer all necessary equipment required for proper inspection of drilled shaft excavations.

1.4.5 Pre-Construction Conference

After submittals are received and approved but before drilled shaft excavation and foundation work, including associated work, is performed, the Contracting Officer will hold a pre-construction conference to review the following:

- a. The drawings, specifications and the geotechnical report.
- b. Finalize construction schedule and verify availability of materials, Excavator's personnel, equipment, and facilities needed to make progress and avoid delays.
- c. Methods and procedures related to drilled shaft foundation installation, including engineer's written instructions.
- d. Support conditions for compliance with requirements, including alignment between foundation system and erection of structural members.
- e. Governing regulations and requirements for, certificates, insurance, tests and inspections if applicable.
- f. Temporary protection requirements for foundation assembly during and

after installation.

1.5 PROJECT CONDITIONS

1.5.1 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit work to proceed without water entering into the area of excavation.

1.6 SEQUENCING

1.6.1 Drilled Shaft Excavation

Perform excavation of drilled shafts so that reinforcing steel and concrete placement is a continuous operation performed the same day that the excavation is completed. Do not leave final excavations open overnight. Disposal shall be in accordance with DREDGING REQUIREMENTS.

1.6.2 Acceptance

Place concrete within 3 hours after approval by the Contracting Officer of the completed excavation.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

Submit design data for the following:

- a. Mix design data in accordance with paragraph READY-MIX CONCRETE accompanied by the Bill of Lading for Ready Mix Concrete deliveries.

2.1.1 Assembly

Installation drawings are to include, but not limited to, the following items indicating a completely dimensioned layout and location of drilled shafts and concrete placement for foundation system. Submit detailed shop drawings for the following:

- a. Steel reinforcement

2.2 EQUIPMENT

2.2.1 Drilling and Excavation Equipment

Provide drilling and excavation equipment having adequate capacity, including but not limited to, power, torque and down thrust to excavate a hole of diameter and depth indicated. Also provide excavation and over-reaming tools of adequate design, size and strength to perform the work indicated.

Provide special drilling equipment including, but not limited to, rock core barrels, rock tools, air tools and other equipment as necessary to construct the shaft excavation to the size and depth indicated when materials encountered can not be drilled using earth augers and/or over-reaming tools.

Submit certificates substantiating appropriate selection of excavation and

drilling equipment.

2.3 MATERIALS

2.3.1 Steel Pipe Casing

For steel pipe casing requirements, refer to Section 31 62 16.13 STEEL PIPE PILES.

2.3.2 Steel Reinforcement

2.3.2.1 Deformed Steel Bars

Steel bars conforming to ASTM A706/A706M, Grade 60 ksi and ACI 318, galvanized after fabrication in accordance with ASTM A767/A767M, Class I.

2.3.2.2 Plain Steel Wire

Steel wire conforming to ASTM A1064/A1064M, galvanized.

2.3.3 Ready-Mix Concrete

Ready-Mix concrete and mix design conforming to ACI 117, ACI 301, and ACI 304R, minimum compressive strength 5,000 psi at 28 days, maximum water to cementitious ratio (w/cm) 0.45. Slump results between 8 to 10 inches, according to ASTM C143/C143M. Or the KTR may use a mix design from 03 31 30 MARINE CONCRETE

Portland cements conforming to ASTM C150/C150M, Type I, Type I/II, or Type II. Provide one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

Potable water conforming to ASTM C94/C94M.

Measure, batch, mix and deliver concrete according to ASTM C94/C94M and furnish batch ticket information.

PART 3 EXECUTION

3.1 PREPARATION

Protect existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled shaft foundation operations.

Provide Fall Protection as required by Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS and 29 CFR 1926.651.

3.2 INSTALLATION

3.2.1 Construction Criteria

Provide equipment for checking the dimensions and alignment of each shaft excavation. Determine dimensions and alignment jointly with the Contractor and Contracting Officer. Measure final shaft depths with appropriate weighted tape measure or other approved method after cleaning.

Provide and install monolithically cast-in-place concrete drilled shaft foundation to the sizes indicated.

Provide and install straight cylindrical shaft foundation of the type indicated.

Tolerances:

- a. Maximum variation of the center of any shaft foundation from the required location: 3 inches, measured at the ground surface.
- b. Bottom Diameter: Minus zero, plus 6 inches, measured in any direction.
- c. Maximum variation from plumb: 1:40.
- d. Maximum bottom level: Plus or minus 2 inches.
- e. Top of Reinforcing Cage: Plus 1 inch or minus 3 inches.

Drilled shaft excavations and completed shafts not constructed within the required tolerances are unacceptable. The Contractor is responsible for correcting all unacceptable shaft excavations and completed shafts to the satisfaction of the Contracting Officer. Materials and work necessary, including engineering analysis and redesign to complete corrections for out of tolerance drilled shaft excavations must be furnished without either cost to the Government or an extension of the completion dates of the project.

3.2.2 Excavation

Accomplish excavation of shaft foundations by standard excavation methods including, but not limited to, conventional augers fitted with soil and/or rock teeth, or under-reaming tools attached to drilling equipment of adequate size, power, torque and down thrust necessary for the work. The excavation and drilling equipment shall have adequate capacity including power, torque, and down thrust to excavate a hole of both diameter and to a depth of 20 percent beyond the depth indicated on the drawings.

The Contractor's Geotechnical Inspector shall maintain construction method log during shaft excavation. The log shall contain information such as: the description and approximate top and bottom elevation of each soil or rock material, level of water, and remarks.

Workmen must not enter the shaft excavation for any reason unless: both a suitable casing has been installed and the water level has been lowered and stabilized below the level to be occupied, and adequate safety equipment and procedures have been provided to the workmen entering the excavation.

Perform excavation through whatever materials that are encountered to the dimensions, depths and applicable ACI 336.1 tolerances.

Protect excavated walls with temporary watertight steel casings of sufficient length to prevent water intrusion, cave-ins, displacement of surrounding earth, and injury to personnel and damage to construction operations.

Excavate shafts for drilled foundations to indicated elevations. Remove loose debris, materials and/or muck to make bottom surfaces level within ACI 336.1 tolerances.

Excavated materials that are removed from the shaft excavations must be

disposed of by the Contractor.

Remove water from excavated shaft prior to concrete placement.

3.2.3 Obstructions

Remove surface and subsurface obstructions at drilled shaft locations. Such obstructions may include man-made materials, such as old concrete foundations, and natural materials such as cobbles and boulders. Special procedures and/or tools shall be employed by the Contractor after the hole cannot be advanced using conventional augers fitted with soil or rock teeth, drilling buckets and/or under reaming (aside) tools. Such special procedures/tools may include but are not limited to: chisels, boulder breakers, core barrels, air tools, and hand excavation. Blasting is not permitted.

3.2.4 Lost Tools

Drilling tools that are lost in the excavation will not be considered obstructions and must be promptly removed by the Contractor without compensation. All costs due to lost tool removal will be borne by the Contractor, including but not limited to, cost associated with hole degradation due to removal operations or the time the hole remains open.

3.2.5 Casing

- a. Casing material shall be steel, smooth, clean, watertight, and of ample strength to withstand both handling and driving stresses and the pressure of both concrete and the surrounding earth materials. The outside diameter of the steel casing must not be less than the specified size of shaft. No extra compensation will be allowed for concrete required to fill an oversized casing.
- b. The procedures and methods used to install the steel casings must not subject the casing stresses in excess of 50 percent over the basic design allowable for the type of steel specified. After installation, each casing must be inspected using methods proposed in the installation plan above. Any casing that shows bends or kinks or other deformations that would impair the strength or efficiency of the completed shaft must be replaced or repaired in a manner satisfactory to the Engineer. Repairing or replacing any such damaged casing, when ordered to do so by the Contracting Officer, will be at no additional expense.
- c. The casing must extend above water level until installation of reinforcing steel and concrete is completed.
- d. Casing shall be coated in accordance with Specification Section 09 97 13.26 COATING OF STEEL WATERFRONT STRUCTURES.

3.2.6 Steel Reinforcement

Comply with recommendations in the CRSI "Manual of Standard Practice" CRSI 10MSP for fabricating, placing and supporting reinforcement. Shop fabricate steel reinforcement in accordance with ACI SP-66.

When practicable, deliver the reinforcement cage assembly to the jobsite as a complete unit ready for installation. Should it be necessary to make any additional connections and/or splices, provide as indicated on the

approved shop drawings, at-grade level prior to lowering the complete assembly into the hole.

Clean reinforcement of loose rust, mill scale, earth and other foreign materials. Do not tack weld crossing reinforcing bars. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

Reinforcing steel in the shaft must be tied and supported so that the reinforcing steel will remain within the specified tolerances. Concrete spacers or other approved non-corroding spacing devices shall be used at sufficient intervals (near the bottom and at intervals not exceeding 10 feet up the shaft) to insure concentric spacing for the entire cage length. Spacers shall be constructed of approved material equal in quality and durability to the concrete specified in the shaft. The spacers shall be of adequate dimensions to insure a minimum 3 inch annular space between the outside of the reinforcing cage and the casing.

Place reinforcing steel after the shaft excavation is inspected and accepted, but prior to concrete placement. Lower reinforcement steel into the hole in such a manner as to prevent damage to the walls of the excavation. Place, tie and/or clip cage symmetrically about the axis of the shaft. Use centering devices securely attached to the cage to clear the shaft walls and maintain the cage in place throughout the concrete placement operations.

Cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between reinforcing and embedded items, notify the Contracting Officer in order to reconcile conflicts before concrete placement. Position and support anchors and embedded items with appropriate accessories.

The elevation of the top of the steel cage must be checked before and after the concrete is placed. If the rebar cage is not maintained within the specified tolerances, correct to the satisfaction of the Contracting Officer. The drilled shaft shall not be constructed until the Contractor has modified his rebar cage support in a manner satisfactory to the Contracting Officer.

3.2.7 Concrete Placement

A minimum of 50 percent of the base for each shaft must have less than 1/2 inch of sediment immediately prior to concrete placement. Maximum depth of sediment or debris at any place on the base of the shaft must not exceed 1-1/2 inches. Shaft cleanliness is to be determined by the Contractor's Geotechnical Inspector and Contracting Officer by visual inspection (video inspection or shaft quantitative inspection device) for dry shafts or other methods deemed appropriate (video inspection or shaft quantitative inspection device) by the Contracting Officer for wet shafts. Additionally, for dry excavations, the maximum depth of water shall not exceed 3 inches immediately prior to concrete placement.

Keep all equipment, including but not limited to, mixers, pumps, hoses, tools and screeds clean and free of set concrete throughout the placement operation.

Convey concrete from the mixer to place of deposit by best industry methods that prevents segregation and loss of material. Size and design the equipment for conveying concrete to ensure uniform, continuous placement of concrete.

Place concrete in accordance with ACI 318.

Place concrete in a continuous operation and without segregation into dry excavations whenever possible after inspection and written approval by the Contracting Officer. Use all practicable means to obtain a dry excavation before and during concrete placement, or follow aforementioned tremie placement procedures.

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. When hot weather conditions exist that would impair quality and strength of placed concrete, comply with ACI 305R. Comply with ACI 306.1 for cold-weather protection.

3.3 CLEANLINESS AND INSPECTION

The Contractor shall provide access to the Contracting Officer at all times during shaft installation to allow the Contracting Officer or their representative to make observations and/or measurements. Casing installation, shaft excavation, rock socket inspection, reinforcing installation, concrete placement and non-destructive shaft testing shall only be performed when the Contracting Officer is present at the shaft location. The Contractor shall also provide equipment for checking the dimensions and alignment of each shaft excavation and for evaluation of the rock socket. Final shaft depths will be measured by the Contracting Officer after final cleaning. A minimum of 50 percent of the base of each shaft shall have less than 0.5 inch of sediment at the time of placement of the concrete. The maximum thickness of sediment or debris at any place at the base of the socket shall not exceed 1.5 inches. The Contracting Officer will determine if shaft cleanliness requirements are met using methods deemed appropriate to the Contracting Officer for wet shafts including but not limited to probing and underwater inspections (see below).

The Contractor shall provide equipment for checking the length, diameter and alignment of each rock socket excavation using means approved by the Contracting Officer. Electronic measuring equipment may be used, but is not required. The Contracting Officer will measure the final bottom of socket depth after cleaning. Prior to the placement of underwater concrete and prior to making final measurements of bottom of rock socket (by Contracting Officer), the Contractor shall use an approved drilled shaft inspection device as outlined in Contractor Submittal to provide a comprehensive underwater inspection of the prepared rock socket bearing surface at each shaft. The Contractor shall record drilled shaft inspection device observations on DVD or other reliable digital media. The date, shaft number, and camera position shall be recorded on the DVD. Copies of all data (written, electronic, DVDs, digital files, etc.) obtained during inspections shall be submitted to the Contracting Officer for review and become property of the Navy.

The Contractor shall provide and maintain facilities for the Contracting Officer to inspect each drilled shaft as needed during advancement of the excavation, to evaluate conditions at the bottom of shaft excavation immediately prior to placing reinforcing steel, and if requested by the Contracting Officer, prior to placement of drilled shaft concrete. Concrete placement shall not begin until all inspection reports related to drilled shaft excavation, tolerances, drilled shaft excavation soundness and cleanliness, including drilled shaft inspection device records, are submitted to the Contracting Officer and the Contracting Officer's

acceptance has been obtained.

3.4 FIELD QUALITY CONTROL

3.4.1 Fresh Concrete Properties

For each concrete mixture, the Contractor shall take samples in accordance with ASTM C172/C172M, test and record the slump, and temperature. If the slump deviates from the previous batch by more than 1 inch, air content shall also be determined. Adjustment of air content and/or slump with chemical admixture is permitted provided the water to cementitious material ratio is not exceeded.

3.4.1.1 Slump Tests

ASTM C143/C143M. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved high range water reducing (HRWR) admixture provided that the water-cementitious ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 50 cubic yards (maximum) of concrete. If concrete does not pass slump test, adjust using a HRWR and test every concrete batch until two consecutive batches meet slump without adjustment.

3.4.1.2 Temperature Tests

- a. Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions below 50 degrees F and above 80 degrees F for each batch (minimum) or every 50 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.
- b. Determine temperature of each concrete sample in accordance with ASTM C1064/C1064M. Temperatures must comply with the Concrete Temperature Control Plans.

3.4.1.3 Air Content Tests

ASTM C231/C231M or ASTM C173/C173M. Perform tests at commencement of concrete placement each day, when test cylinders are made, and if slump test varies by more than 1 inch from previous results or concrete does not pass slump test.

3.4.2 Hardened Concrete Properties

Sample and test at each socketed pile location.

Cast and cure specimens in accordance with ASTM C172/C172M, ASTM C31/C31M, and applicable requirements of ACI 305R and ACI 306R.

For each lot, record the date and time sampled, the batch ticket code, cylinder ID code the location of placement, total volume of concrete represented by the sample, and fresh concrete properties; ASTM C143/C143M for slump or ASTM C1611/C1611M for slump flow and visual stability index (VSI), ASTM C231/C231M for air content, ASTM C1064/C1064M for temperature, and ASTM C138/C138M unit weight.

For each lot sample, cast seven 6 by 12 inch cylinder specimens for strength and three 4 by 8 inch cylinder specimens for chloride ion

penetration testing. These cylinders shall be wrapped completely with slightly dampened paper towels with water only. The wrapped cylinders shall be placed in either a vacuum package or double layers of sealed plastic bags. Package cylinders to prevent damage and ship to the approved testing laboratory.

In the event quality acceptance test results and retest results fail to meet the quality acceptance criteria, the entire lot shall be considered non-conforming material, refer to the paragraph REPAIR, REHABILITATION and REMOVAL.

3.4.2.1 Compressive Strength Tests

ACI 214R tests for strength - conduct strength tests of concrete during construction in accordance with the following procedures:

- a. Test cylinders in accordance with ASTM C39/C39M. Test two cylinders at 3 days, two cylinders at 7 days, and two cylinders at the age when the compressive strength requirement was specified. Hold the remaining cylinder in storage. If one specimen in a test shows evidence of improper sampling, molding or testing, discard the specimen and consider the strength of the remaining cylinder to be the test result. If more than one specimen shows excess defects, the Contracting Officer may allow the entire test to be discarded. Test results shall not exceed the specified compressive strength by more than 20 percent for the age specified.
- b. Strength test reports shall be provided within 7 days of test completion.

3.4.3 Acceptance of Concrete Strength

3.4.3.1 Standard Molded and Cured Strength Specimens

The acceptance of concrete strengths shall be based on averages of results from three consecutive compressive strength tests. When the averages of all sets of three consecutive compressive strength test results are between 1.0 and 1.2 times the field test strength (fcr), and no individual strength test falls below fcr by more than 500 psi, the strength of the concrete is satisfactory. These criteria also apply when accelerated strength testing is specified unless another basis for acceptance is specified.

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SECTION 32 05 33

LANDSCAPE ESTABLISHMENT

08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D5851 (1995; R 2015) Planning and Implementing a
Water Monitoring Program

TREE CARE INDUSTRY ASSOCIATION (TCIA)

TCIA Z133 (2017) American National Standard for
Arboricultural Operations - Pruning,
Repairing, Maintaining, and Removing
Trees, and Cutting Brush - Safety
Requirements

1.2 DEFINITIONS

1.2.1 Pesticide

Any substance or mixture of substances, including biological control agents, that may prevent, destroy, repel, or mitigate pests and are specifically labeled for use by the U.S. Environmental Protection Agency (EPA). Also, any substance used as a plant regulator, defoliant, disinfectant, or biocide. Examples of pesticides include fumigants, herbicides, insecticides, fungicides, nematocides, molluscicides and rodenticides.

1.2.2 Stand of Turf

95 percent ground cover established of the specified species.

1.2.3 Planter Beds

A planter bed is defined as an area containing one or a combination of the following plant types: shrubs, vines, wildflowers, annuals, perennials, ground cover, and a mulch topdressing excluding turf. Trees may also be found in planter beds.

1.3 RELATED REQUIREMENTS

Section 32 92 19 SEEDING applies to this section for installation of seed requirements, with additions and modifications herein.

Section 32 93 00 EXTERIOR PLANTS applies to this section for installation of trees, shrubs, ground cover, and wildflowers, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Integrated Pest Management Plan; G

SD-03 Product Data

Fertilizer; G

Mulches Topdressing

Organic Mulch Materials

SD-07 Certificates

Maintenance Inspection Report

Plant Quantities; G

SD-10 Operation and Maintenance Data

Maintenance

SD-11 Closeout Submittals

Tree Staking Removal

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Delivery

Deliver fertilizer to the site in original containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer, may be furnished in bulk with a certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Fertilizer, and Mulch Storage

Store material in designated areas. Store lime and fertilizer in cool, dry locations away from contaminants.

1.5.2.2 Antidesiccant's Storage

Do not store with fertilizers or other landscape maintenance materials.

1.5.3 Handling

Do not drop or dump materials from vehicles.

1.6 MAINTENANCE

Submit Operation and Maintenance (O&M) Manuals for planting materials. Include instructions indicating procedures during one typical year including variations of maintenance for climatic conditions throughout the year. Provide instructions and procedures for watering; promotion of growth, including fertilizing, pruning, and mowing; and integrated pest management. O&M Manuals must include pictures of planting materials cross referenced to botanical and common names, with a description of the normal appearance in each season.

Develop a water monitoring program for surface and ground water on the project site in accordance with ASTM D5851 and consistent with the water management program utilized during construction operations.

PART 2 PRODUCTS

2.1 POST-PLANT FERTILIZER

Fertilizer for groundcover, wildflowers, and grasses is not permitted. Provide fertilizer for trees, plants, and shrubs as recommended by plant supplier, except synthetic chemical fertilizers are not permitted. Fertilizers containing petrochemical additives or that have been treated with pesticides or herbicides are not permitted.

2.1.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

- 4 percent available nitrogen
- 4 percent available phosphorus
- 4 percent available potassium

2.2 WATER

Source of water must be approved by the Contracting Officer and be of suitable quality for irrigation. Use collected storm water or graywater when available.

2.3 MULCHES TOPDRESSING

Free from noxious weeds, mold, pesticides, or other deleterious materials.

2.3.1 Organic Mulch Materials

Mulch shall be 100% fine-shredded pine bark, of uniform size.

2.4 PESTICIDES

Pesticides and herbicides are not permitted. Submit an Integrated Pest Management Plan. Use biological pest controls as approved in the Plan.

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide landscape construction maintenance to include mowing, edging,

watering, weeding, pruning, and stake adjusting for all newly installed landscape areas unless indicated otherwise, and at all areas inside or outside the limits of the construction that are disturbed by the Contractor's operations.

3.1.1 Policing

Police all landscaped areas. Policing includes removal of leaves, branches and limbs regardless of length or diameter, dead vegetation, paper, trash, cigarette butts, garbage, rocks or other debris. Collected debris must be promptly removed and disposed of at an approved disposal site.

3.1.2 Drainage System Maintenance

Remove all obstructions from surface and subsurface drain lines to allow water to flow unrestricted in swales, gutters, catch basins, storm drain curb inlets, and yard drains. Remove grates and clear debris in catch basins. Open drainage channels are to be maintained free of all debris and vegetation at all times. Edges of these channels must be clear of any encroachment by vegetation.

3.2 IRRIGATION ESTABLISHMENT PERIOD

3.2.1 Water Restrictions

Abide by state, local, or other water conservation regulations in force during the establishment period. Automatic controller must be adjusted to comply with the water conservation regulations schedule.

3.2.2 Fire Hydrants

To use a fire hydrant for irrigation, obtain prior clearance from the Contracting Officer and provide the tools and connections approved for use on fire hydrants. If a fire hydrant is used, Provide a reduced pressure backflow preventer for each connection between hose and fire hydrant. Backflow preventer used must be tested once per month by a certified backflow preventer tester.

3.3 GROUNDCOVER ESTABLISHMENT PERIOD

Groundcover establishment period will commence on the date that inspection by the Contracting Officer shows that the new turf furnished under this contract has been satisfactorily installed to a 95 percent stand of coverage. The establishment period must continue for a period of 365 days.

3.3.1 Frequency of Maintenance

Begin maintenance immediately after turf has been installed. Inspect areas once a week during the installation and establishment period and perform needed maintenance promptly.

3.3.2 Promotion of Growth

Maintain groundcover in a manner that promotes proper health, growth, natural color. Turf must have a neat uniform manicured appearance, free of bare areas, ruts, holes, weeds, pests, dead vegetation, debris, and unwanted vegetation that present an unsightly appearance. Mow, remove excess clippings, eradicate weeds, water, fertilize, and perform other

operations necessary to promote growth, as approved by Contracting Officer and consistent with approved Integrated Pest Management Plan. Remove noxious weeds common to the area from planting areas by mechanical means.

3.3.3 Mowing

3.3.3.1 Turf

Mow turf at a uniform finished height. Mow turfed areas to a minimum average height of 3 - 3 1/2 inches when average height of grass becomes 4 inches for spring/summer maintenance and to a minimum average height of 2 - 2 1/2 inches prior to the first frost for fall winter maintenance. The height of turf is measured from the soil. Perform mowing of turf in a manner that prevents scalping, rutting, bruising, uneven and rough cutting. Prior to mowing, all rubbish, debris, trash, leaves, rocks, paper, and limbs or branches on a turf area must be picked up and disposed. Adjacent paved areas must be swept/vacuumed clean.

3.3.4 Turf Edging and Trimming

Perimeter of planter bed edges, sidewalks, driveways, curbs, and other paved surfaces must be edged. Uniformly edge these areas to prevent encroachment of vegetation onto paved surfaces and to provide a clear-cut division line between planter beds, turf, and ground cover. Edging is to be accomplished in a manner that prevents scalping, rutting, bruising, uneven and rough cutting. Perform edging on the same day that turf is mowed. Use of string line trimmers is permitted in "soft" areas such as an edge between turfgrass and a planter bed. Exercise care to avoid damage to any plant materials, structures, and other landscape features.

Trimming around trees, fences, poles, walls, and other similar objects is to be accomplished to match the height and appearance of surrounding mowed turf growth. Trimming must be performed on the same day the turf's mowed. Care must be exercised to avoid "Girdling" trees located in turf areas. The use of protective tree collars on trees in turf areas may be utilized as a temporary means to avoid injury to tree trunks. At the end of the plant establishment period Contractor will be responsible for removing all protective tree collars.

3.3.5 Post-Fertilizer Application

Do not fertilize wildflowers, groundcover, and grasses. Apply turf fertilizer in a manner that promotes health, growth, vigor, color and appearance of cultivated turf areas. The method of application, fertilizer type and frequencies must be determined by the laboratory soil analysis results the requirements of the particular turf species. Organic fertilizer must be used. In the event that organic fertilizer is not producing the desired effect, the Contractor must contact the Contracting Officer for approval prior to the use of a synthetic type of fertilizer. Apply fertilizer by approved methods in accordance with the manufacturer's recommendations.

3.3.6 Turf Watering

Perform irrigation in a manner that promotes the health, growth, color and appearance of cultivated vegetation and that complies with all Federal, State, and local water agencies and authorities' directives. The Contractor must be responsible to prevent over watering, water run-off, erosion, and ponding due to excessive quantities or rate of application.

Abide by state, local or other water conservation regulations or restrictions in force during the establishment period.

3.3.7 Turf Clearance Area

Trees located in turf areas must be maintained with a growth free clearance of 18 inches from the tree trunk base. The use of mechanical weed whips to accomplish the turf growth free bed area is prohibited.

3.3.8 Replanting

Replant in accordance with Section 32 92 19 SEEDING and within specified planting dates areas which do not have a satisfactory stand of turf. Replant areas which do not have a satisfactory stand of other groundcover and grasses.

3.3.9 Final Inspection and Acceptance

Final inspection will be made upon written request from the Contractor at least 10 days prior to the last day of the turf establishment period. Final turf acceptance will be based upon a satisfactory stand of turf. Final acceptance of wildflower and grass areas will be based upon a stand of 95 percent groundcover of established species.

3.3.10 Unsatisfactory Work

When work is found to not meet design intent and specifications, maintenance period will be extended at no additional cost to the Government until work has been completed, inspected and accepted by Contracting Officer.

3.4 EXTERIOR PLANT ESTABLISHMENT PERIOD

The exterior plant establishment period will commence on the date that inspection by the Contracting Officer shows that the new plants furnished under this contract have been satisfactorily installed and must continue for a period of 365 days.

3.4.1 Frequency of Maintenance

Begin maintenance immediately after plants have been installed. Inspect exterior plants at least once a week during the installation and establishment period and perform needed maintenance promptly.

3.4.2 Promotion of Plant Growth and Vigor

Water, prune, fertilize, mulch, adjust stakes, guys and turnbuckles, eradicate weeds and perform other operations necessary to promote plant growth, and vigor.

3.4.3 Planter Bed Maintenance

Planter beds must be weeded, fertilized, irrigated, kept pest free, turf free, pruned, and mulch levels maintained. Planter beds will not be allowed to encroach into turf areas. A definite break must be maintained between turf areas and planter beds. Fertilize exterior planting materials to promote healthy plant growth without encouraging excessive top foliar growth. Remove noxious weeds common to the area from planting areas by mechanical means.

3.4.3.1 Shrub Selective Maintenance

In addition to the above requirements, shrubs must be selectively pruned, and shaped for health and safety when the following conditions exist: Remove growth in front of windows, over entrance ways or walks, and any growth which will obstruct vision at street intersections or of security personnel; Remove dead, damaged or diseased branches or limbs; where shrub growth obstructs pedestrian walkways; where shrub growth is found growing against or over structures; where shrub growth permits concealment of unauthorized persons. Dispose of all pruning debris in a proper manner.

3.4.3.2 Tree Maintenance

Tree maintenance must include adjustment of stakes, ties, guy supports, watering, fertilizing, pest control, mulching, pruning for health and safety and fall leaf cleanup. Fertilize exterior trees to promote healthy plant growth without encouraging excessive top foliar growth. Inspect and adjust stakes, ties, guy supports to avoid girdling and promote natural development. All trees within the project boundaries, regardless of caliper, must be selectively pruned for safety and health reasons. These include but are not limited to removal of dead and broken branches and correction of structural defects. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Pruning of all trees including palm trees must be accomplished by or in the presence of a certified member of the International Society of Arboriculture and in accordance with TCIA Z133. All pruning debris generated must be disposed of in a proper manner.

3.4.4 Slope Erosion Control Maintenance

Provide slope erosion control maintenance to prevent undermining of all slopes in newly landscaped areas. Maintenance tasks include immediate repairs to weak spots in sloped areas. Eroded areas must be filled with amended topsoil and replanted with the same plant species. Erosion control blankets damaged due to slope erosion must be reinstalled.

3.4.5 Removal of Dying or Dead Plants

Remove dead and dying plants and provide new plants immediately upon commencement of the specified planting season, and replace stakes, mulch and eroded earth mound water basins. Provide an additional 90 day establishment period for replacement plants beyond the original warranty period. A tree must be considered dying or dead when the main leader has died back, or a minimum of 20 percent of the crown has died. A shrub or ground cover must be considered dying or dead when a minimum of 20 percent of the plant has died. This condition must be determined by scraping on a branch an area 1/16 inch square, maximum, to determine the cause for dying plant material and must provide recommendations for replacement. The Contractor must determine the cause for dying plant material and provide recommendations for replacement.

3.4.6 Tracking of Unhealthy Plants

Note plants not in healthy growing condition, as determined by the Contracting Officer, and as soon as seasonal conditions permit, remove and replace with plants of the same species and sizes as originally specified. Install replacement plantings in accordance with Section 32 93 00 EXTERIOR PLANTS.

3.4.7 Final Inspection

Final inspection will be made upon written request from the Contractor at least 10 days prior to the last day of the establishment period. Final inspection will be based upon satisfactory health and growth of plants and on the following:

3.4.7.1 Total Plants on Site

Plants have been accepted and required number of replacements have been installed.

3.4.7.2 Mulching and Weeding

Planter beds and earth mound water basins are properly mulched and free of weeds.

3.4.7.3 Tree Supports

Stakes and guys are in good condition.

3.4.7.4 Remedial Work

Remedial measures directed by the Contracting Officer to ensure plant material survival and promote healthy growth have been completed.

3.4.8 Unsatisfactory Work

When work is found to not meet design intent and specifications, maintenance period will be extended at no additional cost to the Government until work has been completed, inspected and accepted by Contracting Officer.

3.5 FIELD QUALITY CONTROL

3.5.1 Maintenance Inspection Report

Provide maintenance inspection report to assure that landscape maintenance is being performed in accordance with the specifications and in the best interest of plant growth and survivability. Site observations must be documented at the start of the establishment period, then quarterly following the start, and at the end of establishment period. Submit results of site observation visits to the Contracting Officer within 7 calendar days of each site observation visit.

3.5.2 Plant Quantities

Provide Contracting Officer with the number of plant quantities. In addition, provide total exterior area of hardscape and landscaping such as turf and total number of shrubs.

3.5.3 Tree Staking Removal

Provide a certified letter that all stakes and guys are removed from all project trees at the end of the establishment period.

-- End of Section --

SECTION 32 11 23

AGGREGATE BASE COURSES
08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 88	(2013) Standard Method of Test for Particle Size Analysis of Soils
AASHTO T 180	(2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C29/C29M	(2017a) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C88	(2018) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C131/C131M	(2020) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates
ASTM D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2487	(2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM E11	(2020) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Gravel borrow shall conform to the requirements of Section M.01.02 of the Rhode Island DOT Standard Specifications.

1.2.2 Graded-Crushed Aggregate Base Course

Crushed stone shall conform to the requirements of Section M.01.05.3 of the Rhode Island DOT Standard Specifications.

1.2.3 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve will be expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools; G

SD-06 Test Reports

Initial Tests; G
In-Place Tests; G

1.4 EQUIPMENT, TOOLS, AND MACHINES

All plant, equipment, and tools used in the performance of the work will be subject to approval by the Contracting Officer before the work is started. Maintain all plant, equipment, and tools in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Use equipment capable of minimizing segregation, producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.5 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor. Perform sampling and testing using a laboratory approved in accordance with Section 01 45 00.00 10 QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements and perform testing at the specified frequency. The Contracting Officer may specify the time and location of the tests. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Take samples for laboratory testing in conformance with ASTM D75/D75M. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

1.5.2.1 Sieve Analysis

Perform sieve analysis in conformance with ASTM C117 and ASTM C136/C136M using sieves conforming to ASTM E11.

1.5.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with ASTM D4318.

1.5.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture content in accordance with paragraph DEGREE OF COMPACTION.

1.5.2.4 Field Density Tests

Measure field density in accordance with ASTM D1556/D1556M, ASTM D2167 or ASTM D6938. For the method presented in ASTM D1556/D1556M use the base plate as shown in the drawing. For the method presented in ASTM D6938 check the calibration curves and adjust them, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D6938 result in a wet unit weight of soil and ASTM D6938 will be used to determine the moisture content of the soil. Also check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938. Make the calibration checks of both the density and moisture gauges using the prepared containers of material method, as described in paragraph Calibration of ASTM D6938, on each different type of material being tested at the beginning of a job and at intervals as directed. Submit calibration curves and related test results prior to using the device or equipment being calibrated.

1.5.2.5 Wear Test

Perform wear tests on ABC and GCA course material in conformance with ASTM C131/C131M.

1.5.2.6 Soundness

Perform soundness tests on GCA in accordance with ASTM C88.

1.5.2.7 Weight of Slag

Determine weight per cubic foot of slag in accordance with ASTM C29/C29M on the ABC and GCA course material.

1.6 ENVIRONMENTAL REQUIREMENTS

Perform construction when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

PART 2 PRODUCTS

2.1 AGGREGATES

Provide ABC and GCA consisting of clean, sound, durable particles of crushed stone, crushed gravel, angular sand, or other approved material. Provide ABC that is free of lumps of clay, organic matter, and other objectionable materials or coatings.

2.1.1 Coarse Aggregate

Provide coarse aggregates with angular particles of uniform density. Separately stockpile coarse aggregate supplied from more than one source.

- a. Crushed Gravel: Provide crushed gravel that has been manufactured by crushing gravels and that meets all the requirements specified below.
- b. Crushed Stone: Provide crushed stone consisting of freshly mined quarry rock, meeting all the requirements specified below.
- c. Crushed Recycled Concrete: Provide crushed recycled concrete consisting of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. Provide recycled concrete that is free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and that has been crushed and processed to meet the required gradations for coarse aggregate. Reject recycled concrete aggregate exceeding this value. Provide crushed recycled concrete that meets all other applicable requirements specified below.
- d. Crushed Slag: Provide crushed slag that is an air-cooled blast-furnace product having an air dry unit weight of not less than 70 pcf as determined by ASTM C29/C29M, and meets all the requirements specified below.

2.1.1.1 Gravel Borrow

Gravel borrow shall conform to the requirements of Section M.01.02 of the Rhode Island DOT Standard Specifications.

2.1.1.2 Crushed Stone

Crushed stone shall conform to the requirements of Section M.01.05.4 of the Rhode Island DOT Standard Specifications.

2.1.1.3 Filter Stone

Filter stone shall conform to the requirements of Section M.01.07 of the Rhode Island DOT Standard Specifications.

2.1.2 Fine Aggregate

Provide fine aggregates consisting of angular particles of uniform density.

2.1.2.1 Aggregate Base Course

Provide ABC fine aggregate that consists of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.2.2 Graded-Crushed Aggregate Base Course

Provide GCA fine aggregate consisting of angular particles produced by crushing stone, slag, recycled concrete, or gravel that meets the requirements for wear and soundness specified for GCA coarse aggregate.

2.1.3 Gradation Requirements

Apply the specified gradation requirements to the completed base course. Provide aggregates that are continuously well graded within the limits specified in TABLE 1. Use sieves that conform to ASTM E11.

TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
-----	-----	-----	-----
2 inch	100	----	----
1-1/2 inch	70-100	100	----
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-8	0-8	0-8

NOTE 1: Particles having diameters less than 0.02 mm must not be in excess of 3 percent by weight of the total sample tested as determined in accordance with AASHTO T 88.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, test the materials in accordance with ASTM C127 and ASTM C128 to determine their specific gravities. Correct the percentages passing the various sieves as directed by the Contracting Officer if the specific gravities vary by more than 10 percent.

2.2 LIQUID LIMIT AND PLASTICITY INDEX

Apply liquid limit and plasticity index requirements to the completed course and to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve must be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Initial Tests

Perform one of each of the following tests, on the proposed material prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. Complete this testing for each source if materials from more than one source are proposed.

- a. Sieve Analysis.
- b. Liquid limit and plasticity index.
- c. Moisture-density relationship.
- d. Wear.

Submit certified copies of test results for approval not less than 30 days before material is required for the work.

2.3.2 Approval of Material

Tentative approval of material will be based on initial test results.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC or GCA is constructed in more than one layer, clean the previously constructed layer of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Provide adequate drainage during the entire period of construction to prevent water from collecting or standing on the working area.

3.2 OPERATION OF AGGREGATE SOURCES

Condition aggregate sources on private lands in accordance with local laws or authorities.

3.3 STOCKPILING MATERIAL

Clear and level storage sites prior to stockpiling of material. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated. Stockpile aggregates on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Stockpile materials obtained from different sources separately.

3.4 PREPARATION OF UNDERLYING COURSE OR SUBGRADE

Clean the underlying course or subgrade of all foreign substances prior to constructing the base course(s). Do not construct base course(s) on underlying course or subgrade that is frozen. Construct the surface of the underlying course or subgrade to meet specified compaction and surface tolerances. Correct ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the specified requirements set forth herein by loosening and removing soft or unsatisfactory material and adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in ASTM D2487, stabilize the surface prior to placement of the base course(s). Stabilize by mixing ABC or GCA into the underlying course and compacting by approved methods. Consider the stabilized material as part of the underlying course and meet all requirements of the underlying course. Do not allow traffic or other operations to disturb the finished underlying course and maintain in a satisfactory condition until the base course is placed.

3.5 GRADE CONTROL

Provide a finished and completed base course conforming to the lines, grades, and cross sections shown. Place line and grade stakes as necessary for control.

3.6 MIXING AND PLACING MATERIALS

Mix the coarse and fine aggregates in a stationary plant. Make adjustments in mixing procedures or in equipment, as directed, to obtain

true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification. Place the mixed material on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. Place the layers so that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, clean the previously constructed layers of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Make adjustments in placing procedures or equipment as may be directed by the Contracting Officer to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

3.7 LAYER THICKNESS

Compact the completed base course to the thickness indicated. No individual layer may be thicker than 6 inches nor be thinner than 3 inches in compacted thickness. Compact the base course(s) to a total thickness that is within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course will be considered as conforming to the specified thickness requirements. The average job thickness will be the average of all thickness measurements taken for the job and must be within 1/4 inch of the thickness indicated. Measure the total thickness of the base course at intervals of one measurement for each 500 square yards of base course. Measure total thickness using 3 inch diameter test holes penetrating the base course.

3.8 COMPACTION

Compact each layer of the base course, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in this Section. Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Slightly vary the length of alternate trips of the roller. Adjust speed of the roller as needed so that displacement of the aggregate does not occur. Compact mixture with hand-operated power tampers in all places not accessible to the rollers. Continue compaction until each layer is compacted through the full depth to at least 100 percent of laboratory maximum density. Make such adjustments in compacting or finishing procedures as may be directed by the Contracting Officer to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course. Remove any materials found to be unsatisfactory and replace with satisfactory material or rework, as directed, to meet the requirements of this specification.

3.9 PROOF ROLLING

In addition to the compaction specified, proof roll areas designated on the drawings by application of 3 coverages of a heavy pneumatic-tired roller having four or more tires abreast, each tire loaded to a minimum of 30,000 pounds and inflated to a minimum of 125 psi. A coverage is defined as the application of one tire print over the designated area. In the

areas designated, apply proof rolling to the top of the underlying material on which the base course is laid and to the top of each layer of base course. Maintain water content of the underlying material and each layer of the base course as specified in Paragraph COMPACTION from start of compaction to completion of proof rolling of that layer. Remove any base course materials or any underlying materials that produce unsatisfactory results by proof rolling and replace with satisfactory materials. Then recompact and proof roll to meet these specifications.

3.10 EDGES OF BASE COURSE

Place the base course(s) so that the completed section will be a minimum of 2 feet wider, on all sides, than the next layer that will be placed above it. Place approved material along the outer edges of the base course in sufficient quantity to compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, simultaneously roll and compact at least a 2 foot width of this shoulder material with the rolling and compacting of each layer of the base course, as directed.

3.11 FINISHING

Finish the surface of the top layer of base course after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Do not add thin layers of material to the top layer of base course to meet grade. If the elevation of the top layer of base course is 1/2 inch or more below grade, scarify the top layer to a depth of at least 3 inches and blend new material in and compact and proof roll to bring to grade. Make adjustments to rolling and finishing procedures as directed by the Contracting Officer to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, scarify the unsatisfactory portion and rework and recompact it or replace as directed.

3.12 SMOOTHNESS TEST

Construct the top layer so that the surface shows no deviations in excess of 3/8 inch when tested with a 12 foot straightedge. Take measurements in successive positions parallel to the centerline of the area to be paved. Also take measurements perpendicular to the centerline at 50 foot intervals. Correct deviations exceeding this amount by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.13 FIELD QUALITY CONTROL

3.13.1 In-Place Tests

Perform each of the following tests on samples taken from the placed and compacted gravel borrow. Take samples and test at the rates indicated.

- a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 250 square yards, or portion thereof, of completed area.
- b. Perform sieve analysis on every lift of material placed and at a frequency of one sieve analysis for every 500 square yards, or portion thereof, of material placed.

- c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.
- d. Measure the thickness of the base course at intervals providing at least one measurement for each 500 square yards of base course or part thereof. Measure the thickness using test holes, at least 3 inch in diameter through the base course.

3.13.2 Approval of Material

Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and fully compacted course(s).

3.14 TRAFFIC

Completed portions of the base course may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Do not allow heavy equipment on the completed base course except when necessary for construction. When it is necessary for heavy equipment to travel on the completed base course, protect the area against marring or damage to the completed work.

3.15 MAINTENANCE

Maintain the base course in a satisfactory condition until the full pavement section is completed and accepted. Immediately repair any defects and repeat repairs as often as necessary to keep the area intact. Retest any base course that was not paved over prior to the onset of winter to verify that it still complies with the requirements of this specification. Rework or replace any area of base course that is damaged as necessary to comply with this specification.

3.16 DISPOSAL OF UNSATISFACTORY MATERIALS

Dispose of any unsuitable materials that have been removed outside the limits of Government-controlled land. No additional payments will be made for materials that have to be replaced.

-- End of Section --

SECTION 32 12 16.16

ROAD-MIX ASPHALT PAVING
11/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 156	(2013; R 2017) Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
AASHTO T 304	(2011; R 2015) Standard Method of Test for Uncompacted Void Content of Fine Aggregate
AASHTO T 329	(2015) Standard Test Method for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method

ASPHALT INSTITUTE (AI)

AI MS-2	(2015) Asphalt Mix Design Methods
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ASTM INTERNATIONAL (ASTM)

ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C566	(2013) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates
ASTM D979/D979M	(2015) Sampling Bituminous Paving Mixtures

ASTM D2041/D2041M	(2011) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2172/D2172M	(2017; E 2018) Standard Test Methods for Quantitative Extraction of Asphalt Binder from Asphalt Mixtures
ASTM D2726/D2726M	(2019) Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D3203/D3203M	(2017) Standard Test Method for Percent Air Voids in Compacted Asphalt Mixtures
ASTM D3665	(2012; R 2017) Standard Practice for Random Sampling of Construction Materials
ASTM D3666	(2016) Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D5361/D5361M	(2016) Standard Practice for Sampling Compacted Asphalt Mixtures for Laboratory Testing
ASTM D5444	(2015) Mechanical Size Analysis of Extracted Aggregate
ASTM D5821	(2013; R 2017) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6307	(2019) Standard Test Method for Asphalt Content of Asphalt Mixture by Ignition Method
ASTM D6925	(2014) Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
ASTM D6926	(2020) Standard Practice for Preparation of Asphalt Mixture Specimens Using Marshall Apparatus
ASTM D6927	(2015) Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL

PROCEDURES:

SD-02 Shop Drawings

Placement Plan; G

SD-03 Product Data

Diamond Grinding Plan; G

Mix Design; G

Contractor Quality Control; G

SD-04 Samples

Aggregates

SD-06 Test Reports

Aggregates; G

QC Monitoring

SD-07 Certificates

Asphalt Cement Binder; G

Laboratory Accreditation and Validation

1.3 ACCEPTANCE

1.3.1 Acceptability of Work

Acquire the services of an independent commercial laboratory to perform acceptance testing. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. The materials and the pavement itself will be accepted on the basis of production testing. The Government may make check tests from split samples to validate the results of the production testing. Testing performed by the Government does not reduce the required testing of the independent commercial laboratory. Split samples will be taken for Government testing to reduce the variability between the independent commercial laboratory and the Government's test results. When the difference between the independent commercial laboratory and the Government's test results for split samples exceed the acceptable range of two results for multilaboratory precision for the appropriate test method (i.e. ASTM) then at least one of the laboratories is determined to be in error. An evaluation of procedures and equipment in both laboratories will be made to determine the cause(s) for the differences. Develop steps to correct procedures and equipment to bring multilaboratory precision to within acceptable limits.

1.3.2 Acceptance Requirements

Provide all sampling and testing required for acceptance. Where appropriate, for individual lots of asphalt pavement will be made based on laboratory air voids, in-place density, smoothness, and grade in accordance with the following paragraphs. Surface smoothness and grade determinations will be made on the lot as a whole. Exceptions or

adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses, thus smoothness and grade measurements for the entire lot cannot be made.

1.3.3 Pavement Lots

A standard lot for all requirements is equal to one day's production or 2,000 tons, whichever is smaller. Divide each lot into four equal sublots in order to evaluate laboratory air voids and in-place density. When operational conditions cause a lot to be terminated before the specified four sublots have been completed, use the following procedure to adjust the lot size and number of tests for the lot. Where three sublots have been completed, they constitute a lot. Where one or two sublots have been completed, incorporate them into the next lot and the total number of sublots (i.e. 5 or 6 sublots) is used for acceptance criteria. Include partial lots at the end of asphalt production into the previous lot. Complete and report all theoretical maximum density, laboratory air voids, and in-place density testing within 24 hours after construction of each lot.

1.3.4 Sublot Sampling

Take one mixture sample for each sublot in accordance with ASTM D979/D979M from a random truck or another location for determining theoretical maximum density, laboratory air voids, any additional testing the Government desires, and Contractor Quality Control. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D3665 and employing tables of random numbers or computer programs.

1.3.5 Additional Sampling and Testing

The Government reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government. Testing in these areas will be treated as a separate lot. Payment Acceptance will be made for the quantity of asphalt pavement represented by these tests in accordance with the provisions of this section.

1.3.6 Theoretical Maximum Density (TMD)

Measure theoretical maximum density one time for each sublot in accordance with ASTM D2041/D2041M for purposes of calculating laboratory air voids and determining in-place density. The average TMD for each lot will be determined as the average TMD of the random sublot samples. When the TMD on both sides of a longitudinal joint is different, the average of these two TMD values will be used as the TMD needed to calculate the percent joint density.

1.3.7 Laboratory Air Voids

Prepare one set of laboratory compacted specimens for each sublot in accordance with ASTM D6926 using the hand-held hammer for the Marshall Method. Prepare one set of laboratory compacted specimens for each sublot in accordance with ASTM D6925 using the Superpave gyratory compactor. Provide three test specimens prepared from the same sample for each set of laboratory compacted specimens. Compact the specimens within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Do not

reheat samples prior to compaction. Provide insulated containers as necessary to maintain the sample temperature. Measure the bulk density of laboratory compacted specimens in accordance with ASTM D2726/D2726M. Determine laboratory air voids from one set (three laboratory compacted specimens) for each subplot sample in accordance with ASTM D3203/D3203M.

1.3.7.1 Tolerance

Provide laboratory air voids with a mean absolute deviation of 1.00 percent or less from the JMF for each lot. Remove and replace lots that do not meet the laboratory air voids requirement at least 4 inches into the cold (existing) lane adjacent to the longitudinal joint, at no additional cost to the Government. The mean absolute deviation of the laboratory air void contents from the JMF air void content will be evaluated as shown in the example below.

1.3.7.2 Calculating Laboratory Air Voids

Laboratory air void calculations for each lot will use the average theoretical maximum density values obtained for the lot. Determine the average TMD in accordance with paragraph THEORETICAL MAXIMUM DENSITY (TMD). The mean absolute deviation of the laboratory air void contents (one from each subplot) from the JMF air void content will be evaluated as in the following example:

Assume that the laboratory air voids are determined from 4 sublots where one set of laboratory compacted specimens is from a single subplot. The laboratory air voids for the 4 sublots are determined to be 3.5, 3.0, 4.0, and 3.7. Assume that the target air voids from the JMF is 4.0. The mean absolute deviation is then:

$$\text{Mean Absolute Deviation} = (|3.5 - 4.0| + |3.0 - 4.0| + |4.0 - 4.0| + |3.7 - 4.0|)/4$$

$$\text{Mean Absolute Deviation} = (0.5 + 1.0 + 0.0 + 0.3)/4 = (1.8)/4 = 0.45$$

The mean absolute deviation for laboratory air voids is determined to be 0.45. It can be seen that 0.45 is less than 1.00 percent. The lot is acceptable for laboratory air voids.

1.3.8 In-place Density

Obtain one random 4 inch or 6 inch diameter core from the mat and joint of each subplot in accordance with ASTM D5361/D5361M for determining in-place density. Cut samples neatly with a diamond core drill bit. Obtain random cores that are the full thickness of the layer being placed. Select core locations randomly using the procedures contained in ASTM D3665. Locate cores for mat density no closer than 12 inches from a transverse or longitudinal joint including the pavement edge. Center all cores for joint density on the joint. Discard samples that are clearly defective as a result of sampling and take an additional random core. When the random core is less than 1 inch thick, it will not be included in the analysis. In this case, obtain another random core sample. Clean and tack coat dry core holes before filling with asphalt mixture. Fill all core holes with asphalt mixture and compact using a standard Marshall hammer to the density specified. Provide all tools, labor, and materials for cutting samples, cleaning, and filling the cored pavement. Measure in-place density in accordance with ASTM D2726/D2726M using each core obtained from the mat and joint.

1.3.8.1 Tolerance

Provide a minimum in-place mat density of 93.0 percent and a minimum in-place joint density of 90.0 percent for each lot. The average in-place mat and joint densities are expressed as a percentage of the average theoretical maximum density (TMD) for the lot. Determine the average TMD in accordance with paragraph THEORETICAL MAXIMUM DENSITY (TMD). Remove and replace lots that do not meet the in-place mat density requirement at least 4 inches into the cold (existing) lane adjacent to the longitudinal joint, at no additional cost to the Government. Remove and replace the longitudinal joint when the lot does not meet the in-place joint density, at no additional cost to the Government. Use a 10 feet wide paving lane that is centered over the joint.

1.3.9 Surface Smoothness

Use a straightedge for measuring surface smoothness. Use the straightedge method for transverse testing, for longitudinal testing where the length of each pavement lane is less than 0.25 miles, and at the ends of the paving limits for the project. Smoothness requirements do not apply over crowns or grade breaks. Maintain detailed notes of the testing results and provide a copy to the Government immediately after each day's testing.

1.3.9.1 Smoothness Requirements

1.3.9.1.1 Straightedge Testing

Provide finished surfaces of the pavements with no abrupt change of 1/4 inch or more when checked with an approved 12 foot straightedge. Remove and replace surface lift lots when the surface smoothness exceeds 3/8 inch, at no additional cost to the Government. High spots can be diamond ground as an alternative to remove and replace in order to meet surface smoothness requirements at individual locations.

1.3.9.2 Testing Method

After the final rolling, but not later than 24 hours after placement, test the surface of the pavement in each entire lot in a manner to reveal surface irregularities exceeding the tolerances specified above. If any pavement areas are diamond ground, retest these areas immediately after diamond grinding. The maximum area allowed to be corrected by diamond grinding is 10 percent of the total area of the lot. Check a number of random locations along with any observed suspicious locations primarily at transverse and longitudinal joints with the straightedge.

1.3.9.2.1 Straightedge Testing

Use the straightedge to measure abrupt changes in surface smoothness. Hold the straightedge in contact with the pavement surface and measure the maximum distance between the straightedge and the pavement surface. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

1.3.9.2.2 Bumps ("Must Grind" Areas)

Reduce any bumps ("must grind" areas) shown on the profilograph trace which exceed 0.4 inch in height by diamond grinding until they do not exceed 0.3 inch when retested. Taper diamond grinding in all directions to provide smooth transitions to areas not requiring diamond grinding. The following will not be permitted: (1) skin patching for correcting low areas, (2) planing or milling for correcting high areas. At the Contractor's option, pavement areas including diamond ground areas can be rechecked with the profilograph in order to record a lower Profile Index. Perform additional profilograph testing in all areas corrected by diamond grinding.

1.3.10 Plan Grade

Provide a final wearing surface of pavement conforming to the elevations and cross sections shown and not vary more than 0.05 foot from the plan grade established and approved at site of work. Within 5 working days after completion of a particular lot incorporating the final wearing course, test the final wearing surface of the pavement for conformance with specified plan grade requirements. Match finished surfaces at juncture with other pavements with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. For roads, the grade will be determined by running lines of levels along the centerline at intervals of 25 feet or less longitudinally to determine the elevation of the completed pavement surface. Measure transverse grades at appropriate intervals. For parking lots, the grade will be determined by running lines of levels at intervals of 25 feet or less longitudinally and transversely to determine the elevation of the completed pavement surface. Diamond grinding can be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted. Maintain detailed notes of the results of the testing and provide a copy to the Government immediately after each day's testing.

Remove and replace surface lift lots when individual locations exceed 0.05 foot tolerance, at no additional cost to the Government. High spots can be diamond ground as an alternative to remove and replace in order to meet plan grade requirements at individual locations.

1.3.11 Laboratory Accreditation and Validation

Provide laboratories used to develop the Job Mix Formula (JMF), perform acceptance testing, and Contractor Quality Control testing that meet the requirements of ASTM D3666. Provide laboratories with a masonry saw having a diamond blade for trimming pavement cores and samples. Perform all required test methods by an accredited laboratory. Schedule and provide payment for laboratory inspections. Additional payment or a time extension due to failure to acquire the required laboratory accreditation is not allowed. The Government will inspect the laboratory equipment and test procedures prior to the start of hot-mix warm-mix operations for conformance with ASTM D3666. In addition, all testing laboratories performing acceptance testing require USACE validation by the Material Testing Center (MTC) for both parent laboratory and plant testing laboratory. Validation on all laboratories is required to remain current throughout the duration of the paving project. Contact the MTC manager listed at <https://mtc.erdcdren.mil> for costs and scheduling. Submit a certificate of compliance signed by the manager of the laboratory stating

that it meets these requirements to the Government prior to the start of construction. At a minimum, include the following certifications:

- a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.
- b. A listing of equipment to be used in developing the job mix.
- c. A copy of the laboratory's quality control system.

1.4 ENVIRONMENTAL REQUIREMENTS

Do not place the asphalt mixture upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 3 Table 1. The temperature requirements may be waived by the Government, if requested; however, meet all other requirements including compaction.

Table 3. Table 1. Surface Temperature Limitations of Underlying Course	
Mat Thickness, inches	Degrees F
3 or greater	40
Less than 3	45

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Perform the work consisting of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. Provide asphalt pavement designed and constructed in accordance with this section conforming to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Construct each course to the depth, section, or elevation required by the drawings and rolled, finished, and approved before the placement of the next course. Submit proposed Placement Plan indicating lane widths and longitudinal joints for each course or lift.

2.1.1 Asphalt Mixing Plant

Provide plants used for the preparation of asphalt mixture conforming to the requirements of AASHTO M 156 with the following changes:

2.1.1.1 Truck Scales

Weigh the asphalt mixture on approved scales, or on certified public scales at no additional expense to the Government. Inspect and seal scales at least annually by an approved calibration laboratory.

2.1.1.2 Inspection of Plant

Provide access to the Government at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. Provide assistance as requested, for the Government to procure

any desired samples.

2.1.1.3 Storage bins

The asphalt mixture can be stored in non-insulated storage bins for a period of time not exceeding 3 hours. The asphalt mixture can be stored in insulated storage bins for a period of time not exceeding 8 hours. Provide the mix drawn from bins that meets the same requirements as mix loaded directly into trucks.

2.1.2 Hauling Equipment

Provide trucks used for hauling asphalt mixture that have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, lightly coat the truck beds with a minimum amount of paraffin oil, lime solution, or other approved material. Do not use petroleum based products as a release agent. Provide each truck with a suitable cover to protect the mixture from adverse weather, contamination, and loss of material during hauling. When necessary due to long haul distance and cold weather, provide insulated truck beds with covers (tarps) that are securely fastened.

2.1.3 Material Transfer Vehicle (MTV)

Provide Material Transfer Vehicle for placement of the asphalt mixture. Transfer the material from the hauling equipment to the paver using a self-propelled, material transfer vehicle with a swing conveyor that is capable of delivering material to the paver without making contact with the paver. Provide MTV capable to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. Provide Material Transfer Vehicle with remixing and storage capability to prevent physical and thermal segregation.

2.1.4 Asphalt Pavers

Provide mechanical spreading and finishing equipment consisting of a self-powered paver, capable of spreading and finishing the mixture to the specified line, grade, and cross section. Provide paver screed capable of laying a uniform mixture to meet the specified thickness, smoothness, and grade without physical or temperature segregation, the full width of the material being placed. Provide a paver with a vibrating screed to be used during all placement.

2.1.4.1 Receiving Hopper

Provide paver with a receiving hopper of sufficient capacity to permit a uniform spreading operation and a distribution system to place the mixture uniformly in front of the screed without segregation. Provide a screed that effectively produces a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

2.1.4.2 Automatic Grade Controls

Provide a paver equipped with a control system capable of maintaining the specified screed elevation. One of three methods can be used to control grade: stringline, laser, or computerized elevations along with GPS. For multiple layers it is acceptable to control the grade in the underlying layer and control the grade of the surface layer by applying a constant

thickness over the underlying layer which has been placed to the desired grade. Slope control can also be used to control the grade of the surface for roads, but is not acceptable for wide pavements such as parking lots. Provide transverse slope controller capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A ski-type device of not less than 30 ft can be used to provide improved smoothness. Use a shoe on one side of the paver to match an existing paved surface to provide a smooth joint.

2.1.5 Rollers

Provide rollers in good condition and operate at slow speeds to avoid displacement of the asphalt mixture. Provide sufficient number, type, and weight of rollers to compact the mixture to the required density while it is still in a workable condition. Do not use equipment which causes excessive crushing of the aggregate.

2.1.6 Diamond Grinding

Those performing diamond grinding are required to have a minimum of three years experience in diamond grinding. In areas not meeting the specified limits for surface smoothness and plan grade, reduce high areas to attain the required smoothness and grade, except as depth is limited below. Reduce high areas by diamond grinding the asphalt pavement with approved equipment. Perform diamond grinding by sawing with saw blades impregnated with an industrial diamond abrasive. Assemble the saw blades in a cutting head mounted on a machine designed specifically for diamond grinding that produces the required texture and smoothness level without damage to the asphalt pavement or joint faces. Provide diamond grinding equipment with saw blades that are 1/8-inch wide, a minimum of 60 blades per 12 inches of cutting head width, and capable of cutting a path a minimum of 3 feet wide. Diamond grinding equipment that causes raveling, fracturing of aggregate, or disturbance to the underlying material will not be allowed. The maximum area corrected by diamond grinding the surface of the asphalt pavement is 10 percent of the total area of any lot. The maximum depth of diamond grinding is 1/2 inch. Provide diamond grinding machine equipped to flush and vacuum the pavement surface. Dispose of all debris from diamond grinding operations off Government property. Prior to diamond grinding, submit a Diamond Grinding Plan for review and approval. At a minimum, include the daily reports for the deficient areas, the location and extent of deficiencies, corrective actions, and equipment. Remove and replace all pavement areas requiring plan grade or surface smoothness corrections in excess of the limits specified.

Prior to production diamond grinding operations, perform a test section at the approved location, consisting of a minimum of two adjacent passes with a minimum length of 40 feet to allow evaluation of the finish and transition between adjacent passes. Production diamond grinding operations cannot be performed prior to approval.

2.2 AGGREGATES

Notify the Government at least 7 days before sampling aggregates. Obtain samples in accordance with ASTM D75/D75M that are representative of the materials to be used for the project. Provide aggregates consisting of crushed stone, crushed gravel, crushed slag, screenings, natural sand, and mineral filler as required. The portion of material retained on the No. 4 sieve is coarse aggregate. The portion of material passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate. The portion

passing the No. 200 sieve is defined as mineral filler. Submit sufficient materials to produce 200 pounds of blended mixture for mix design verification. Submit all aggregate test results and samples to the Government at least 14 days prior to start of construction. Perform job aggregate testing no earlier than 6 months before contract award.

2.2.1 Coarse Aggregate

Conform to requirements of Section M.03.02.2a of RI DOT Standard Specifications.

2.2.2 Fine Aggregate

Conform to requirements of Section M.03.02.2b of RI DOT Standard Specifications.

2.2.3 Mineral Filler

Conform to requirements of Section M.03.02.3 of RI DOT Standard Specifications.

2.3 ASPHALT CEMENT BINDER

Conform to requirements of Section M.03.03 of RI DOT Standard Specifications.

2.4 MIX DESIGN

Develop the mix design in accordance with Section 401.02.3 of RI DOT Standard Specifications.

2.4.1 JMF Requirements

Submit the proposed JMF in writing, for approval, at least 14 days prior to the start of the test section. The JMF shall include the requirements contained in Section 401.02.03 of RI DOT Standard Specifications.

2.4.2 Adjustments to JMF

The JMF for each mixture is in effect until a new formula is approved in writing by the Government. Should a change in sources of any materials be made, perform a new mix design and a new JMF approved before the new material is used.

2.5 RECYCLED HOT MIX ASPHALT

Provide reclaimed asphalt pavement in accordance with Section 407 of RI DOT Standard Specifications.

PART 3 EXECUTION

3.1 CONTRACTOR QUALITY CONTROL

3.1.1 General Quality Control Requirements

Submit the Quality Control Plan. Do not produce hot-mix asphalt for payment acceptance until the quality control plan has been approved. In the quality control plan, address all elements which affect the quality of the pavement including, but not limited to:

- a. Mix Design and unique JMF identification code
- b. Aggregate Grading
- c. Quality of Materials
- d. Stockpile Management and procedures to prevent contamination
- e. Proportioning including percent of warm-mix additive
- f. Mixing and Transportation
- g. Mixture Volumetrics
- h. Moisture Content of Mixtures
- i. Placing and Compaction
- j. Joints
- k. Surface Smoothness
- l. Truck bed release agent

3.1.2 Testing Laboratory

Provide a fully equipped asphalt laboratory located at the plant or job site that is equipped with heating and air conditioning units to maintain a temperature of 75 plus or minus 5 degrees F. Provide laboratory facilities that are kept clean and all equipment maintained in proper working condition. Provide the Government with unrestricted access to inspect the laboratory facility, to witness quality control activities, and to perform any check testing desired. The Government will advise in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, immediately suspend the incorporation of the materials into the work. Incorporation of the materials into the work will not be permitted to resume until the deficiencies are corrected.

3.1.3 Quality Control Testing

Perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. Use the independent commercial laboratory for acceptance testing in paragraph ACCEPTANCE. Use in-house capabilities or the independent commercial laboratory for quality control testing. Required elements of the testing program include, but are not limited to tests for the control of asphalt content, aggregate gradation, aggregate moisture, moisture in the asphalt mixture, temperatures, VMA, Marshall stability, flow, and in-place density. Develop a Quality Control Testing Plan as part of the Quality Control Program.

3.1.3.1 Asphalt Content

Determine asphalt content a minimum of twice per lot (a lot is defined in paragraph PAVEMENT LOTS) using the ignition method in accordance with ASTM D6307. Use the extraction method in accordance with ASTM D2172/D2172M

if the correction factor for the ignition method in ASTM D6307 is greater than 1.0. The asphalt content for the lot will be determined by averaging the test results.

3.1.3.2 Aggregate Properties

Determine aggregate gradations a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with ASTM D5444, ASTM C136/C136M, and ASTM C117. Determine the specific gravity of each aggregate size grouping for each 20,000 tons in accordance with ASTM C127 or ASTM C128. Determine fractured faces for gravel sources for each 20,000 tons in accordance with ASTM D5821. Determine the uncompacted void content of natural sand, manufactured sand, and blended aggregate for each 20,000 tons in accordance with AASHTO T 304 Method A.

3.1.3.3 Moisture Content of Aggregate

Determine the moisture content of aggregate used for production a minimum of once per lot in accordance with ASTM C566.

3.1.3.4 Moisture Content of Asphalt Mixture

Determine the moisture content of the asphalt mixture at least once per lot in accordance with AASHTO T 329.

3.1.3.5 Temperatures

Check temperatures at least four times per lot, at necessary locations to determine the temperature at the dryer, the asphalt cement binder in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.1.3.6 VMA, Marshall Stability, and Flow

Obtain mixture samples at least four times per lot. Calculate the VMA of each specimen in accordance with AI MS-2 based on ASTM C127 and ASTM C128 bulk specific gravity for the aggregate, as well as the Marshall stability and flow, as described in ASTM D6927. Provide VMA within the limits of Table 5 Table 3.

3.1.3.7 In-Place Density

Conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge or other non-destructive testing device can be used to monitor pavement density.

3.1.3.8 Additional Testing

Perform any additional testing deemed necessary to control the process.

3.1.3.9 QC Monitoring

Submit all QC test results to the Government on a daily basis as the tests are performed. The Government reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.1.4 Sampling

When directed by the Government, sample and test any material which appears to not meet specification requirements unless such material is voluntarily removed and replaced or deficiencies corrected. Perform all sampling in accordance with standard procedures specified.

3.1.5 Control Charts

For process control, establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 6 Table 4, as a minimum. Post the control charts as directed by the Government and maintain current at all times. Identify the following on the control charts: the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 6 Table 4 applicable to the test parameter being plotted, and the test results. Also show target values (JMF) on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, halt production until the problem is solved. When the Suspension Limit is exceeded for individual values or running average values, the Government has the option to require removal and replacement of the material represented by the samples or to leave in place and base acceptance on mixture volumetric properties and in place density. Use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Make decisions concerning mix modifications based on analysis of the results provided in the control charts. In the Quality Control Plan, indicate the appropriate action to be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 6. Table 4. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts				
Parameter to be Plotted	Individual Samples		Running Average of	
	Action Limit	Suspension Limit	Action Limit	Suspension Limit
No. 4 sieve, Cumulative percent passing, deviation for JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative percent passing, deviation for JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative percent passing, deviation for JMF target; plus or minus values	1.4	2.0	1.1	1.5
Asphalt content, percent deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Stability, pounds (minimum) (NA for Superpave)				
75 Blow JMF	1800	1700	1900	1800
50 Blow JMF	1000	900	1100	1000

Table 6. Table 4. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts				
	Individual Samples		Running Average of	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
Flow, 0.01 inch (NA for Superpave)				
75 Blow JMF	8 min.	7 min.	9 min.	8 min.
	16 max.	17 max.	15 max.	16 max.
50 Blow JMF	8 min.	7 min.	9 min.	8 min.
	18 max.	19 max.	17 max.	18 max.
Laboratory Air Voids, percent deviation from JMF target value	No specific action and suspension limits set since this parameter is used for acceptance			
In-place Mat Density, percent of TMD	No specific action and suspension limits set since this parameter is used for acceptance			
In-place Joint Density, percent of TMD	No specific action and suspension limits set since this parameter is used for acceptance			
VMA				
Gradation 1	13.5	13.0	13.3	13.0
Gradation 2	14.5	14.0	14.3	14.0
Gradation 3	15.5	15.0	15.3	15.0

3.2 PREPARATION OF ASPHALT BINDER MATERIAL

Heat the asphalt cement material while avoiding local overheating. Provide a continuous supply of the asphalt material to the mixer at a uniform temperature. Maintain the temperature of the asphalt delivered to the mixer to provide a suitable viscosity for adequate coating of the aggregate particles. For hot-mix, do not heat unmodified asphalt to a temperature exceeding 325 degrees F when added to the aggregate. Do not heat modified asphalt to a temperature exceeding 350 degrees F when added to the aggregate.

3.3 PREPARATION OF MINERAL AGGREGATE

Heat and dry the aggregate prior to mixing. Provide a rate of heating and a maximum temperature that does not damage the aggregates. Do not heat the aggregate to a temperature exceeding 350 degrees F when the asphalt binder is added. Maintain the temperature no lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.4 PREPARATION OF ASPHALT MIXTURE

Weigh or meter the aggregates and the asphalt cement and introduce into the mixer the amount specified by the JMF. Mix the combined materials until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. The moisture content of all asphalt mixture upon discharge from the plant is not to exceed 0.5 percent by total weight of mixture as measured by AASHTO T 329.

3.5 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the asphalt mixture, clean the underlying course of dust and debris and apply a tack coat in accordance with RI DOT

Specifications, Section 403.

3.6 TEST SECTION

Prior to full production, place a test section for each JMF used. Construct a test section 250 to 500 feet long and two paver passes wide with a longitudinal cold joint. Do not place the second lane of test section until the temperature of pavement edge is less than 175 degrees F. Construct the test section with the same depth as the course which it represents. Ensure the underlying grade or pavement structure upon which the test section is to be constructed is the same or very similar to underlying layer for the project. Use the same equipment and procedures in construction of the test section as on the remainder of the course represented by the test section. Construct the test section as part of the project pavement, as approved by the Government.

3.6.1 Sampling and Testing for Test Section

Obtain one sample at the plant from a random truck. Compact three specimens and test for laboratory air voids as well as the Marshall stability and flow. Test a portion of the same sample for theoretical maximum density (TMD), aggregate gradation, asphalt content, and TSR. Adjust the compactive effort as required to provide TSR specimens with an air void content of 7 plus or minus 1 percent. Obtain four randomly selected cores from each finished pavement mat (eight total), four from the longitudinal joint, and test for density. Perform random sampling in accordance with procedures contained in ASTM D3665. Construction may continue provided the test results are within the tolerances or exceed the minimum values shown in Table 7 Table 5. If all test results meet the specified requirements, the test section may remain as part of the project pavement. If test results exceed the tolerances shown, remove and replace the test section and construct another test section at no additional cost to the Government.

Table 7. Table 5. Test Section Requirements for Material and Mixture Properties	
Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
No. 4 and larger	JMF plus or minus 8
No. 8, No. 16, No. 30, and No. 50	JMF plus or minus 6
No. 100 and No. 200	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
VMA, Percent (Average of 3 specimens)	See Table 5 Table 3

Table 7. Table 5. Test Section Requirements for Material and Mixture Properties	
Property	Specification Limit
Tensile Strength Ratio (TSR) (At 7 percent plus/minus 1 percent air void content)	75 percent minimum
Conditioned Strength	60 psi minimum
Mat Density, Percent of TMD (Average of 4 Random Cores)	92.0 - 96.0 93.0 minimum
Joint Density, Percent of TMD (Average of 4 Random Cores)	89.5 minimum 90.0 minimum
Stability, pounds (Average of 3 specimens) (for Marshall only)	1000 minimum for 50 blows
Flow, 0.01 inch (Average of 3 specimens) (for Marshall only with non-modified asphalt)	8 - 18 for 50 blows

3.6.2 Additional Test Sections

If the initial test section should prove to be unacceptable, make the necessary adjustments to the JMF, plant operation, placing procedures, and rolling procedures before beginning construction of a second test section. Construct and evaluate additional test sections, as required, for conformance to the specifications. Full production paving is not allowed until an acceptable section has been constructed and accepted.

3.7 TRANSPORTING AND PLACING

3.7.1 Transporting

Transport asphalt mixture from the mixing plant to the site in clean, tight vehicles. Schedule deliveries so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Provide adequate artificial lighting for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F.

3.7.2 Placing

Place the mix in lifts of adequate thickness and compact at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, place the mixture to the full width by an asphalt paver; strike off in a uniform layer of such depth that, when the work is completed, the required thickness is obtained and the surface conforms to the grade and contour indicated. Do not broadcast waste mixture onto the mat or recycle into the paver hopper. Collect waste mixture and dispose off site. Regulate the speed of the paver to eliminate pulling and tearing of the asphalt mat. Begin placement of the mixture along the centerline of a crowned section or on the high side of

areas with a one-way slope. Place the mixture in consecutive adjacent strips having a minimum width of 10 feet. Offset the longitudinal joint in one course from the longitudinal joint in the course immediately below by at least 1 foot; however, locate the joint in the surface course at the centerline of the pavement. Offset transverse joints in one course by at least 10 feet from transverse joints in the previous course. Offset transverse joints in adjacent lanes a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture can be spread and luted by hand tools.

3.8 COMPACTION OF MIXTURE

3.8.1 General

- a. After placing, thoroughly and uniformly compact the mixture by rolling. Compact the surface as soon as possible without causing displacement, cracking, or shoving. Determine the sequence of rolling operations and the type of rollers used with the exception that application of more than three passes with a vibratory roller in the vibrating mode is prohibited. Maintain the speed of the roller, at all times, sufficiently slow to avoid displacement of the asphalt mixture and to be effective in compaction. Correct at once any displacement occurring as a result of reversing the direction of the roller, or from any other cause.
- b. Furnish sufficient rollers to handle the output of the plant. Continue rolling until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, keep the wheels properly moistened, but excessive water is not permitted. In areas not accessible to the roller, thoroughly compact the mixture with hand tampers or small compactors. Remove the full depth of any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective. Replace with fresh asphalt mixture and immediately compact to conform to the surrounding area. Perform this work at no expense to the Government. Skin patching is not allowed.

3.8.2 Segregation

The Government can sample and test any material that looks deficient. When the in-place material appears to be segregated, the Government has the option to sample the material and have it tested and compared to the aggregate gradation, asphalt content, and in-place density requirements in Table 7. If the material fails to meet these specification requirements, remove and replace the extent of the segregated material the full depth of the layer of asphalt mixture at no additional cost to the Government. When segregation occurs in the mat, take appropriate action to correct the process so that additional segregation does not occur.

3.9 JOINTS

Construct joints to ensure a continuous bond between the courses and to obtain the required density. Provide all joints with the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.9.1 Transverse Joints

Do not pass the roller over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, construct by means of placing a bulkhead or by tapering the course. Utilize a dry saw cut on the transverse joint full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. Remove the cutback material from the project. In both methods, provide a light tack coat of asphalt material to all contact surfaces before placing any fresh mixture against the joint.

3.9.2 Longitudinal Joints

Provide a joint that meets density and smoothness requirements for joints and has uniform texture. Cut back longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing adjacent lanes), or otherwise defective, a maximum of 3 inches from the top of the course with a cutting wheel to expose a clean, sound, near vertical surface for the full depth of the course. Remove all cutback material from the project. Provide a light tack coat of asphalt material to all contact surfaces prior to placing any fresh mixture against the joint.

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SECTION 32 17 23

PAVEMENT MARKINGS

08/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 247 (2013) Standard Specification for Glass
Beads Used in Pavement Markings

AASHTO M 249 (2012; R2016) Standard Specification for
White and Yellow Reflective Thermoplastic
Striping Material (Solid Form)

ASTM INTERNATIONAL (ASTM)

ASTM D4061 (2013) Standard Test Method for
Retroreflectance of Horizontal Coatings

ASTM D6628 (2003; R 2015) Standard Specification for
Color of Pavement Marking Materials

ASTM E1710 (2011) Standard Test Method for
Measurement of Retroreflective Pavement
Marking Materials with CEN-Prescribed
Geometry Using a Portable
Retroreflectometer

ASTM E2177 (2011) Standard Test Method for Measuring
the Coefficient of Retroreflected
Luminance (RL) of Pavement Markings in a
Standard Condition of Wetness

ASTM E2302 (2003; R 2016) Standard Test Method for
Measurement of the Luminance Coefficient
Under Diffuse Illumination of Pavement
Marking Materials Using a Portable
Reflectometer

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 03732 (1997) Selecting and Specifying Concrete
Surface Preparation for Sealers, Coatings,
and Polymer Overlays

MASTER PAINTERS INSTITUTE (MPI)

MPI 97 (2012) Traffic Marking Paint, Latex

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A (2017) Colors used in Government
Procurement

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD (2009; Rev 2012) Manual on Uniform Traffic
Control Devices

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Surface Preparation Equipment List; G

Application Equipment List; G

Exterior Surface Preparation

Safety Data Sheets; G

Waterborne Paint; G

Thermoplastic compound; G

SD-06 Test Reports

Reflective Media for Roads; G

Waterborne Paint; G

Thermoplastic Compound; G

SD-07 Certificates

Qualifications; G

Reflective Media for Roads

Waterborne Paint

Volatile Organic Compound, (VOC); G

Thermoplastic Compound

SD-08 Manufacturer's Instructions

Waterborne Paint; G

Thermoplastic Compound; G

1.3 QUALITY ASSURANCE

1.3.1 Regulatory Requirements

Submit certificate stating that the proposed pavement marking paint meets the Volatile Organic Compound, (VOC) regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located. Submit Safety Data Sheets for each product.

1.3.2 Qualifications

Submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of applicable chemicals. The documentation should include experience on five projects of similar size and scope with references for all personnel.

1.4 DELIVERY AND STORAGE

Deliver paint materials, thermoplastic compound materials, and reflective media in original sealed containers that plainly show the designated name, specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer.

Provide storage facilities at the job site, only in areas approved by the Contracting Officer, for maintaining materials at temperatures recommended by the manufacturer.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Environmental Requirements

1.5.1.1 Weather Limitations for Application

Apply pavement markings to clean, dry surfaces, and unless otherwise approved, only when the air and pavement surface temperature is at least 5 degrees F above the dew point and the air and pavement temperatures are within the limits recommended by the pavement marking manufacturer. Allow pavement surfaces to dry after water has been used for cleaning or rainfall has occurred prior to striping or marking. Test the pavement surface for moisture before beginning work each day and after cleaning. Do not commence marking until the pavement is sufficiently dry and the pavement condition has been approved by the Contracting Officer. Employ the "plastic wrap method" to test the pavement for moisture as specified in paragraph TESTING FOR MOISTURE.

1.5.2 Traffic Controls

Place warning signs conforming to MUTCD near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Place small markers along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Mark painting equipment with large warning signs indicating slow-moving painting equipment in operation.

When traffic must be rerouted or controlled to accomplish the work, provide necessary warning signs, flag persons, and related equipment for

the safe passage of vehicles.

1.5.3 Lighting

When night operations are necessary, provide all necessary lighting and equipment. The Government reserves the right to accept or reject night work on the day following night activities by the Contractor.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 Surface Preparation and Paint Removal

2.1.1.1 Surface Preparation Equipment for Roads and Automotive Parking Areas

Submit a surface preparation equipment list by serial number, type, model, and manufacturer. Include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation. Mobile equipment must allow for removal of markings without damaging the pavement surface or joint sealant. Maintain machines, tools, and equipment used in the performance of the work in satisfactory operating condition.

2.1.2 Application Equipment

Submit application equipment list appropriate for the material(s) to be used. Include manufacturer's descriptive data and certification for the planned use that indicates area of coverage per pass, pressure adjustment range, tank and flow capacities, and all safety precautions required for operating and maintaining the equipment. Provide and maintain machines, tools, and equipment used in the performance of the work in satisfactory operating condition, or remove them from the work site. Provide mobile and maneuverable application equipment to the extent that straight lines can be followed and normal curves can be made in a true arc.

2.1.2.1 Paint Application Equipment

2.1.2.1.1 Hand-Operated, Push-Type Machines

Provide hand-operated push-type applicator machine of a type commonly used for application of water based paint or two-component, chemically curing paint, thermoplastic, or preformed tape, to pavement surfaces for small marking projects, such as legends and cross-walks, automotive parking areas, or surface painted signs. Provide applicator machine equipped with the necessary tanks and spraying nozzles capable of applying paint uniformly at coverage specified. Hand operated spray guns may be used in areas where push-type machines cannot be used.

2.1.2.1.2 Self-Propelled or Mobile-Drawn Spraying Machines

Provide self-propelled or mobile-drawn spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. Provide machine having a speed during application capable of applying the stripe widths indicated at the paint coverage rate specified herein and of even uniform thickness with clear-cut edges.

2.1.2.1.2.1 Road Marking

Provide equipment used for marking roads capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines, or a combination of solid and intermittent lines using a maximum of three different colors of paint as specified.

2.1.2.1.2.2 Hand Application

Provide spray guns for hand application of paint in areas where the mobile paint applicator cannot be used.

2.1.2.2 Thermoplastic Application Equipment

2.1.2.2.1 Thermoplastic Material

Apply thermoplastic material with equipment that is capable of providing continuous uniformity in the dimensions and reflectorization of the marking.

2.1.2.2.2 Application Equipment

- a. Provide application equipment capable of continuous mixing and agitation of the material, with conveying parts which prevent accumulation and clogging between the main material reservoir and the extrusion shoe or spray gun. All parts of the equipment which come into contact with the material must be easily accessible and exposed for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns must maintain the material at the required temperature with heat-transfer oil or electrical-element-controlled heat.
- b. Provide application equipment constructed to ensure continuous uniformity in the dimensions of the stripe. Provide an applicator with a means for cleanly cutting off stripe ends squarely and providing a method of applying "skiplines." Provide equipment capable of applying varying widths of traffic markings.
- c. Provide mobile and maneuverable application equipment allowing straight lines to be followed and normal curves to be made in a true arc. Provide equipment used for the placement of thermoplastic pavement markings of two general types: mobile applicator and portable applicator.
- d. Equip the applicator with a pressurized or drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser must operate automatically to begin flow prior to the flow of binder to assure that the strip is fully reflectorized.

2.1.2.2.3 Mobile Application Equipment

Provide a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method.

- a. Equip the unit to apply the thermoplastic marking material at temperatures according to the manufacturer's instructions, at widths varying from 3 to 12 inches, with an automatic pressurized or drop-on

bead dispensing system, capable of operating continuously, and of installing a minimum of 20,000 lineal feet of longitudinal markings in an 8-hour day.

- b. Equip the mobile unit with a melting kettle which holds a minimum of 6000 pounds of molten thermoplastic material; capable of heating the thermoplastic composition to temperatures as recommended by the manufacturer. Use a thermostatically controlled heat transfer liquid. Heating of the composition by direct flame is not allowed. Oil and material temperature gauges must be visible at both ends of the kettle.
- c. Equip mobile units for application of extruded markings with a minimum of two extrusion shoes; located one on each side of the truck, capable of marking simultaneous edge line and centerline stripes; each being a closed, oil-jacketed unit; holding the molten thermoplastic at a temperature as recommended by the manufacturer; and capable of extruding a line of 3 to 8 inches in width; and at a thickness of not less than 0.120 inch nor more than 0.190 inch, of generally uniform cross section.
- d. Equip mobile units for application of spray markings with a spray gun system capable of marking simultaneous edgeline and centerline stripes. Surround (jacket) the spray system with heating oil to maintain the molten thermoplastic at a temperature of 375 to 425 degrees F, capable of spraying a stripe of 3 to 12 inches in width, and in thicknesses varying from 0.060 inch to 0.098 inch, of generally uniform cross section.
- e. Equip the mobile unit with an electronic programmable line pattern control system, capable of applying skip or solid lines in any sequence, through any and all of the extrusion shoes, or the spray guns, and in programmable cycle lengths. In addition, equip the mobile unit with an automatic counting mechanism capable of recording the number of lineal feet of thermoplastic markings applied to the pavement surface with an accuracy of 0.5 percent.

2.1.2.2.4 Portable Application Equipment

Provide portable hand-operated equipment, specifically designed for placing special markings such as crosswalks, stop bars, legends, arrows, and short lengths of lane, edge and centerlines; and capable of applying thermoplastic pavement markings by the extrusion method. Equip the portable applicator with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, capable of holding the molten thermoplastic at the temperature recommended by the manufacturer, and of extruding a line of 3 to 12 inches in width, and in thickness of not less than 0.120 inch nor more than 0.190 inch and of generally uniform cross section.

2.1.2.3 Reflective Media Dispenser

Attach the dispenser for applying the reflective media to the dispenser and designed to operate automatically and simultaneously with the applicator through the same control mechanism. The bead applicator must be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph APPLICATION.

2.2 MATERIALS

Use waterborne paint for roads. Use non-reflectorized waterborne paint for automotive parking areas. The maximum allowable VOC content of pavement markings is 150 grams per liter. Color of markings are indicated on the drawings and must conform to ASTM D6628 for roads and automotive parking areas and SAE AMS-STD-595A for airfields. Provide materials conforming to the requirements specified herein.

2.2.1 Waterborne Paint

MPI 97

2.2.2 Thermoplastic Compound

2.2.2.1 Composition Requirements

Thermoplastic compound must conform to AASHTO M 249. Formulate the binder component as an alkyd resin.

2.2.2.2 Primer

- a. Asphalt concrete primer: Provide thermosetting adhesive primer with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved or dispersed in a volatile organic solvent for asphaltic concrete pavements. The solids content must not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch, plus or minus 0.001 inch, must dry to a tack-free condition in less than 5 minutes.
- b. Portland cement concrete primer: Provide an epoxy resin primer for Portland cement concrete pavements, of the type recommended by the manufacturer of the thermoplastic composition.

2.2.3 Reflective Media

2.2.3.1 Reflective Media for Roads

AASHTO M 247, Type 1.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Testing for Moisture

Test the pavement surface for moisture before beginning pavement marking after each period of rainfall, fog, high humidity, or cleaning, or when the ambient temperature has fallen below the dew point. Do not commence marking until the pavement is sufficiently dry and the pavement condition has been approved by the Contracting Officer or authorized representative.

Employ the "plastic wrap method" to test the pavement for moisture as follows: Cover the pavement with a 12 inch by 12 inch section of clear plastic wrap and seal the edges with tape. After 15 minutes, examine the plastic wrap for any visible moisture accumulation inside the plastic. Do not begin marking operations until the test can be performed with no visible moisture accumulation inside the plastic wrap. Re-test surfaces when work has been stopped due to rain.

3.1.2 Surface Preparation Demonstration

Prior to surface preparation, demonstrate the proposed procedures and equipment. Prepare areas large enough to determine cleanliness and rate of cleaning. Perform a demonstration removal of pavement marking in an area designated by the Contracting Officer. Approved demonstration area establishes the standard for the remainder of the work.

3.1.3 Test Stripe Demonstration

Prior to paint application, demonstrate test stripe application within the work area using the proposed materials and equipment. Apply separate test stripes in each of the line widths and configurations required herein using the proposed equipment. Make the test stripes long enough to determine the proper speed and operating pressures for the vehicle(s) and machinery, but not less than 50 feet long.

3.1.4 Application Rate Demonstration

During the Test Stripe Demonstration, demonstrate compliance with the application rates specified herein. Document the equipment speed and operating pressures required to meet the specified rates in each configuration of the equipment and provide a copy of the documentation to the Contracting Officer prior to proceeding with the work.

3.1.5 Retroreflective Value Demonstration

After the test stripes have cured to a "no-track" condition, demonstrate compliance with the average retroreflective values specified herein. Take a minimum of ten readings on each test stripe with a Retroreflectometer with a direct readout in millicandelas per square meter per lux (mcd/m²/lx). Perform testing in accordance with ASTM D4061, ASTM E1710, ASTM E2177, and ASTM E2302.

3.1.6 Level of Performance Demonstration

The Contracting Officer will be present at the application demonstrations to observe the results obtained and to validate the operating parameters of the vehicle(s) and equipment. If accepted by the Contracting Officer, the test stripe is the measure of performance required for this project. Do not proceed with the work until the demonstration results are satisfactory to the Contracting Officer.

3.2 EXTERIOR SURFACE PREPARATION

Allow new pavement surfaces to cure for a period of not less than 30 days before application of marking materials. Thoroughly clean surfaces to be marked before application of the paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods as required. Remove rubber deposits, residual curing compounds, and other coatings adhering to the pavement by water blasting.

- a. For Portland Cement Concrete pavement, grinding, light shot blasting, or light scarification, to a resulting profile equal to ICRI 03732 CSP 2, CSP 3, and CSP 4, respectively, can be used in addition to water blasting on most pavements, to either remove existing coatings, or for surface preparation.

3.2.1 Early Painting of Rigid Pavements

Pretreat rigid pavements that require early painting with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride. Apply the solution to the areas to be marked.

3.2.2 Early Painting of Asphalt Pavements

For asphalt pavement systems requiring painting application at less than 30 days, apply the paint and beads at half the normal application rate, followed by a second application at the normal rate after 30 days.

3.3 APPLICATION

Apply pavement markings to dry pavements only.

3.3.1 Paint

Apply paint with approved equipment at rate of coverage specified herein. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking numbers, letters, and symbols. Manually paint numbers, letters, and symbols. Sharply outline all edges of markings. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the markings, painting operations must cease until the cause of the slow drying is determined and corrected.

3.3.1.1 Waterborne Paint

3.3.1.1.1 Roads

Apply paint at a rate of 105 plus or minus 5 square feet per gallon. Apply AASHTO M 247 Type 1 beads at a rate of 7 plus or minus 0.5 pounds of glass spheres per gallon.

3.3.2 Thermoplastic Compound

Place thermoplastic pavement markings, free from dirt or tint, upon dry pavement. The temperature must be a minimum of 40 degrees F and rising at the time of installation. Apply all centerline, skipline, edgeline, and other longitudinal type markings with a mobile applicator. Place all special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable applicator, using the extrusion method.

3.3.2.1 Primer

After surface preparation has been completed, prime the asphalt or concrete pavement surface with spray equipment. Allow primer materials to "set-up" prior to applying the thermoplastic composition. Allow the asphalt concrete primer to dry to a tack-free condition, usually occurring in less than 10 minutes. Allow the Portland cement concrete primer to dry in accordance with the thermoplastic manufacturer recommendations. To shorten the curing time of the epoxy resins, an infrared heating device may be used on the concrete primer. Apply asphalt concrete primer to all asphalt concrete pavements at a wet film thickness of 0.005 inch, plus or minus 0.001 inch (265 to 400 square feet per gallon). Apply Portland cement concrete primer to all concrete pavements (including concrete

bridge decks) at a wet film thickness of between 0.04 to 0.05 inch 320 to 400 square feet per gallon.

After the primer has "set-up", apply the thermoplastic at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Apply all extruded thermoplastic markings at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch. Apply all sprayed thermoplastic markings at the specified width and the thickness designated in the contract plans. If the plans do not specify a thickness, apply centerline markings at a wet thickness of 0.090 inch, plus or minus 0.005 inch, and edgeline markings at a wet thickness of 0.060 inch, plus or minus 0.005 inch.

3.3.2.2 Reflective Media

Immediately after installation of the thermoplastic material, mechanically apply drop-on reflective glass spheres conforming to AASHTO M 247 Type 1 at the rate of one pound per 20 square feet such that the spheres are held by and imbedded in the surface of the molten material. Accomplish drop-on application of the glass spheres to ensure even distribution at the specified rate of coverage. If there is a malfunction of either thermoplastic applicator or reflective media dispenser, discontinue operations until deficiency is corrected.

3.3.3 Cleanup and Waste Disposal

Keep the worksite clean and free of debris and waste from the removal and application operations. Dispose of debris at approved sites.

3.4 FIELD QUALITY CONTROL

3.4.1 Sampling and Testing

As soon as the paint materials are available for sampling, obtain by random selection from the sealed containers, two quart samples of each batch in the presence of the Contracting Officer. Accomplish adequate mixing prior to sampling to ensure a uniform, representative sample. A batch is defined as that quantity of material processed by the manufacturer at one time and identified by number on the label. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use, and quantity involved.

At the discretion of the Contracting Officer, samples provided may be tested by the Government for verification.

3.4.2 Material Inspection

Examine material at the job site to determine that it is the material referenced in the report of test results or certificate of compliance. Provide test results substantiating conformance to the specified requirements with each certificate of compliance.

3.4.3 Dimensional Tolerances

Apply all markings in the standard dimensions provide in the drawings. New markings may deviate a maximum of 10 percent larger than the standard dimension. The maximum deviation allowed when painting over an old marking is up to 20 percent larger than the standard dimensions.

3.4.4 Bond Failure Verification

Inspect newly applied markings for signs of bond failure based on visual inspection and comparison to results from Test Stripe Demonstration paragraph.

3.4.5 Reflective Media and Coating Application Verification

Use a wet film thickness gauge to measure the application of wet paint. Use a microscope or magnifying glass to evaluate the embedment of glass beads in the paint. Verify the glass bead embedment with approximately 50 percent of the individual bead spheres embedded and 50 percent of the individual bead spheres exposed.

-- End of Section --

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SECTION 32 31 13.53

HIGH-SECURITY FENCES (CHAIN LINK) AND GATES
02/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A116	(2011) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A121	(2013) Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A240/A240M	(2020) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A392	(2011a; R 2017) Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A478	(1997; R 2019) Standard Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire
ASTM A491	(2011; R 2017) Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A702	(2013) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A824	(2011; R 2017) Standard Specification for

	Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM A1023/A1023M	(2019) Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
ASTM C94/C94M	(2020) Standard Specification for Ready-Mixed Concrete
ASTM F567	(2014a) Standard Practice for Installation of Chain Link Fence
ASTM F626	(2014) Standard Specification for Fence Fittings
ASTM F844	(2007a; R 2013) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F883	(2013) Padlocks
ASTM F900	(2011; R 2017) Standard Specification for Industrial and Commercial Swing Gates
ASTM F1043	(2018) Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
ASTM F1083	(2018) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F1145	(2017) Standard Specifications for Turnbuckles, Swaged, Welded, Forged
ASTM F1184	(2016) Industrial and Commercial Horizontal Slide Gates
ASTM F1910	(1998; R 2018) Standard Specification for Long Barbed Tape Obstacles
ASTM F1911	(2005; R 2019) Standard Practice for Installation of Barbed Tape

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fence Installation Drawings; G

Vertical Pivot Gate Installation Drawings; G

Automatic Sliding Gate Installation Drawings; G

SD-03 Product Data

Fabric

Posts

Post Caps

Chain Link Braces

Line Posts

Sleeves

Top Rail

Bottom Rail

Tension Wire

Barbed Wire

Barbed Wire Supporting Arms

Barbed Tape

Latches

Hinges

Stops

Keepers

Panic Bars and Trim

Closers

Rollers

Turnstiles

Padlocks

Wire Ties

Slide Gates

Swing Gates

Vertical Pivot Gates

Fence Fabric Reinforcement

SD-07 Certificates

Chain Link Fence

Fabric

Barbed Wire

Gate Hardware and Accessories

Concrete

Gate Operator

SD-10 Operation and Maintenance Data

Electro-Mechanical Locks

Gate Operator

Operating and maintenance instructions

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials elevated off of the ground to protect against oxidation caused by ground contact.

PART 2 PRODUCTS

2.1 COMPONENTS

2.1.1 Chain Link Fence Fabric

2.1.1.1 General

Provide ASTM A392, Class 2, zinc-coated steel wire with minimum coating weight of 2.0 ounces of zinc per square foot of coated surface. ASTM A491, Type I, aluminum-coated steel wire. Fabricate fence fabric of 9 gauge wire woven in 2 inch mesh conforming to ASTM A116. Provide twisted and barbed fabric on the top selvage and knuckled on the bottom selvage.

2.1.2 Posts

2.1.2.1 Metal Posts for Chain Link Fence

Provide posts conforming to ASTM F1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B and Group II, roll-formed steel sections, meeting the strength and coating requirements of ASTM F1043 and ASTM A702. Group III, ASTM F1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Provide either Group IA steel pipe posts, Group IC, Group II, roll-formed steel sections, and be zinc coated (Type A) and polyvinyl chloride coated conforming to the requirements of ASTM F1043. Provide sizes as shown on the drawings. Use line posts and terminal (corner, gate, and pull) posts of the same designation throughout the fence. Provide gate post for the gate type specified subject to the limitation specified in ASTM F900 and/or ASTM F1184.

2.1.2.2 Accessories

2. Provide accessories conforming to ASTM F626. Coat ferrous accessories with zinc.

a. Provide truss rods (with turnbuckles or other means of adjustment) for each terminal post.

b. Provide barbed wire supporting arms of the single 45 degree outward angle 3-strand arm type and of the design required for the post furnished. Secure arms by top rail bolting.

c. Furnish post caps in accordance with manufacturer's standard accessories.

d. Provide 9 gauge steel tie wire for attaching fabric to rails, braces, and posts and match the coating of the fence fabric. Use tie wires for attaching fabric to tension wire on high security fences made from 16 gage stainless steel. Provide double loop tie wires 6.5 inches in length. Provide miscellaneous hardware coatings which conform to ASTM A153/A153M unless modified.

2.1.3 Chain Link Braces and Rails

ASTM F1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Provide Group IC steel pipe, zinc-coated, that meets the strength and coating requirements of ASTM F1043. Use braces and rails that are Group II, formed steel sections, size 1-21/32 inch and be zinc coated (Type A). Group II, formed steel sections, size 1-21/32 inch, conforming to ASTM F1043, may be used as braces and rails if Group II line posts are furnished.

Braces, top rail and bottom rail; Class 1, steel pipe, Grade A or 3, formed steel sections.

2.1.4 Chain Link Gates

2.1.4.1 Gate Assembly

Provide gate assembly conforming to ASTM F900 and/or ASTM F1184 of the type and swing shown. Provide gate frames conforming to strength and coating requirements of ASTM F1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Provide gate frames conforming to strength and coating requirements of ASTM F1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Use gate fabric that matches the specified chain link fabric.

2.1.4.2 Gate Leaves

For gate leaves, more than 8 feet wide, provide either intermediate members and diagonal truss rods or tubular members as necessary to provide rigid construction, free from sag or twist. For gate leaves less than 8 feet wide, provide truss rods or intermediate braces. Provide intermediate braces on all gate frames with an electro-mechanical lock. Attach fabric to the gate frame by method standard with the manufacturer. Welding is not an acceptable method for attaching fabric to gate frames.

2.1.4.3 Gate Hardware and Accessories

Submit manufacturer's catalog data. Furnish and install latches, hinges, stops, keepers, panic bars and trim, rollers, closers, and other hardware items as required for the operation of the gate. All items are required to match the material characteristics of the fence system being installed and be sized correctly for the intended operation and to meet all applicable codes and regulations. Arrange latches for padlocking, if applicable, so that the padlock will be accessible from both sides of the gate. Provide stops for holding the gates in the open position. For high security applications, extend each end member of gate frames sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence. Provide electro-mechanical locks for all personnel swing gates. Provide panic bars to be installed on the secure side of all personnel gates and gates must swing out toward the unsecure side. Provide pull or level type handle on unsecured side of all personnel gates. Panic shields shall be edge style and color shall match fence.

2.1.5 Vertical Pivot Gates

Provide 8-foot height chain link fence vertical pivot gate with barbed wire.

2.1.5.1 Vertical Pivot Gate Construction

Aluminum Assembly Framing:

- a. Plate, shapes and bar: ASTM B221, alloy 6061-T6 or 6063-T6
- b. Extrusions: Alloy and temper 6063-T6, except formed elbows shall be 6063-T4.
- c. Round Aluminum Pipe: Standard weight extruded structural aluminum pipe, alloy 6063-T6, mill finish, complying with ASTM B429.
- d. Provide lock washer or other locking device at all bolted connections.

Steel Assembly Framing:

- a. High strength steel pipe triple coated in accordance with ASTM F1043 Group IC; SS40 as manufactured by Allied Tube & Conduit. External coatings per ASTM F1043 Type B, internal coatings per ASTM F1043 Type D. Post welding treatments: All welding joints to be coated ZRC or equivalent zinc rich coating.
- b. Steel Tubes: ASTM A500 Cold-Formed Welded Pipe and Structural Tubing Hot-Dipped, Zine-Coated.
- c. Steel shapes plates and bars: ASTM A36.

Threaded Fasteners:

- a. All exterior screws, bolts, nut and washers shall be 300 series non-magnetic stainless steel. Provide lock washer or other locking devices such as deformed thread lock or nylon locking nuts at all bolted connections.

Fabrication:

- a. Fabricate frames of gates from aluminum tubing. Assemble gate frames by welding at corners. Infill gate frames with panels to match adjacent fence panels or project specifications.
- b. Configuration: Size and space members in compliance with applicable codes and project specifications. All gate framing members shall be unspliced single pipe or tube length.
- c. Bracing: Provide diagonal welded pipe gate trusses to prevent sag.
- d. Cable Wind Bracing: Required for gates between 16' or more in length and up to 20' in length. Provide 3/16 aircraft coated cable anchored to the operator and at approximately 2/3 the length of the gate.
- e. Masted Wind Bracing: Required for gates over 20' or more in length or more than 7' in height, and/or code requirement beyond 75 mph winds.
- f. Provide continuous tube elements which attach to the operator and extend a minimum of 2/3 the length of the gate. Wind bracing is also secured to the bottom of the gate with strut plates.
- g. Fully assemble gate leaves in the manufacturer's shop with no joints splices or bolted sections. Open tube ends or sections are not acceptable.
- h. Welding: Make exposed joints butt tight, flush, and hairline. Continuously seal joined members by continuous welds.
- i. Fabricated frame and infill fabrics: Epoxy coating, PVC Coating, or unpainted mill finish fabrics to match fence line or project specifications color.
- j. Barbed wire assemblies: Extend gate post and vertical frame members 12 inches above top of chain-link fabric.
- k. Provide components required for receiving yoke anchorage of gate ends. Fabricate anchors and related components of material and finish matching gate frame or specified color.

2.1.6 Padlocks

Provide padlocks conforming to ASTM F883, Type P01, Option A, Grade 6. Size 1-3/4 inch. Key all padlocks into master key system as specified in Section 08 71 00 DOOR HARDWARE.

2.1.7 Gate Operator Sliding

Provide electric gate operators for sliding gate as follows: Provide electric gate operators with a right angle gearhead instantly reversing motor with magnetic drum-type brake, friction disc clutch, reversing starter with thermal overload protection, and a chain-driven geared rotary-type automatic limit switch. Use only hardened steel machine cut worm and mating bronze gears that operate in a bath of oil. Gate operators with V-belt pulleys are not allowed. Equip gate operators with an emergency release to allow the gate to be operated manually that is

also capable of being locked in the engaged or disengaged position. Provide positive stops on the gate tracks as a backup to the limit switches.

2.1.1.8 Electro-Mechanical Locks

Provide electro-mechanical locking devices for sliding and personnel gates that are solenoid actuated such that the deadbolt retracts when the solenoid is energized and remains electrically retracted until the gate is closed. Provide continuous duty type solenoid, rated for 120V ac, 60Hz operation. Ensure the locking device is unlockable by key and keyed on both sides. Monitor status of the electro-mechanical lock by two limit switches (integral to the locking device) wired in series. Ensure one switch monitors the deadlock lever and the other monitors the locking tongue.

2.1.1.9 Gate Operator - Vertical Pivot Gate

Provide gate operator system, including gate operator, manufacturer recommended batteries, external entrapment B1 type Non-Contact sensing devices.

- a. Gate Speed: Fully open to fully closed and fully closed to open not less than 10-12 seconds.
- b. Frequency of Use: Continuous duty.
- c. Battery Powered Back Up DC Drive System: Operator to run on 24 Volt DC current integral power supply with stand-by battery system with built-in battery maintainer and "over-charge" protection.
- d. Field supplied: Provide two (2) 12v batteries, complying with gate operator manufacturer's requirements (Group 24, 12 Volt, Sealed Marine Starting).
- e. Power supply to operator: 120VAC(20 Amp).
- f. Gate Operator Enclosure: Fabricate operator enclosure from steel tubing and sheet metal. Continuous seal weld all frames seams with welds ground smooth. Screwed frames are not acceptable.
- g. Frame: 2" Sq., 11 Ga. (.120)Steel Tubing
- h. Skins: 18 Ga. Galvanneal Sheet
- i. Doors: 14 Ga. Galvanneal Sheet
- j. Mounting Pads: 3" wide x 3/8" thick 304 Stainless Steel.
- k. Finish: Powder coated Black.
- l. Mechanical Gate Operator Drive: 24 VDC high torque gear motor and DBL reduction DBL "V" belt design. Integral right-angle Anti-Back drive and locking preventing falling and unauthorized motor operation. Hydraulic components of any kind are not acceptable.
- m. Control Circuitry: Provide manufacturer supplied control board in electrical enclosure. Ensure weather and moisture-proof integrity. Internal operator factory wiring: 16 & 18 Ga. Single conductor.

Copper with electrolytic copper compression terminals tin-plated for maximum corrosion prevention.

Gate Operator System shall be Listed to UL 325 Class III and the gate panel shall be fabricated in accordance with ASTM F2200.

n. Type A Entrapment Sensing Device - Operator shall have inherent gate position and speed sensing system as part of the gate operator system. Type A shall be constructed such that it may not be removed or bypassed.

o. Operator shall have provision for connection of Control System and for connection of External Entrapment Sensing Devices specified herein after.

External Entrapment Sensing Device: Provide the following external entrapment protection devices as appropriate for the specific site conditions to address all potential entrapment zones. All entrapment areas/zones must be identified by the installer and have physical restrictions of pedestrian access such as fence sections or barrier screening preventing reach through or standing in the entrapment zone or the installer shall supply additional external entrapment protection devices to protect pedestrians in all entrapment areas.

2.1.9.1 Control Systems - Vertical Pivot Gate and Sliding Gates

Operation control system: Remote-control stations, safety devices, and weatherproof enclosures, coordinate electrical requirements with building electrical systems.

- a. Card Reader: Functions only when authorized card is presented.
- b. Vehicle presence detector.
- c. Provide emergency stop button in an outdoor weather tight enclosure

2.1.10 Vehicle Presence Detector - Sliding Gate and Vertical Pivot Gate

Provide a vehicle presence detector compatible with the selected sliding gate and/or vertical pivot gate manufacturer control system. The vehicle presence detector should be able to detect exiting vehicles to automatically operate gates for egress maneuvers and also detect object within the closing pattern of the gate for safe operation. Vehicle presence detectors should use laser-based time-of-flight sensor technology and should be housed in IP65 rated enclosures.

- a. Detection Mode: Motion and presence.
- b. Supply Voltage: 10-35 VDC at sensor terminal.
- c. Typical Response time: 200ms motion detection, 20ms presence detection
- d. Temperature Range: -22 to 144 °F powered, 14 to 140 °F unpowered.

2.2 MATERIALS

2.2.1 Wire

2.2.1.1 Wire Ties

Submit samples as specified. Provide wire ties constructed of the same material as the fencing fabric.

2.2.1.2 Barbed Wire

Provide barbed wire conforming to ASTM A121 zinc-coated, Type Z, Class 3, or aluminum-coated, Type A, with 12.5 gauge wire with 14 gauge, round, 4-point barbs spaced no more than 5 inches apart.

2.2.1.3 Tension Wire

Provide Type I or Type II tension wire, Class 4 coating, in accordance with ASTM A824. Provide 7 gauge coil spring wire for top wire.

2.2.2 Barbed Tape

Provide reinforced barbed tape, single coil, for fence toppings fabricated from 430 series stainless steel with a hardness range of Rockwell (30N) 37-45 conforming to the requirements of ASTM A240/A240M. Provide stainless steel strip 0.025 inch thick by 1 inch wide before fabrication. Provide barbs that are a minimum of 1.2 inch in length, in groups of 4, spaced on 4 inch centers. Use stainless steel core wire with a 0.098 inch diameter and a minimum tensile strength of 140 psi and conforming to ASTM A478.

Ensure long barbed tape obstacles conform to ASTM F1910.

2.2.3 Concrete

ASTM C94/C94M, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Use grout consisting of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.3 FENCE FABRIC REINFORCEMENT

Provide galvanized structural wire rope as indicated and in accordance with ASTM A1023/A1023M, 3/4 inch nominal diameter of strand, 19 wire strand, regular lay, extra improved plow steel (EIPS), independent wire rope core (IWRC) and with a minimum breaking strength of 40,800 pound-force. Galvanize cable, Class A, in accordance with ASTM A1023/A1023M.

2.3.1 Wire Rope Accessories

All structural steel members used in cable anchoring system shall be hot-dipped galvanized. Clamps, U-bolts, and associated hardware shall be hot-dipped galvanized in accordance with ASTM A153/A153M.

2.3.2 Turnbuckles

Turnbuckles shall be 1-1/4 inches x 12 inches x inches Type I, Grade 1 galvanized, in accordance with ASTM F1145.

2.3.3 Rope Clamps

Rope clamps shall be hot-dipped galvanized in accordance with ASTM A153/A153M.

2.3.4 Threaded Rods, U-Bolts, and Bolts

All threaded rods, U-bolts shall conform to ASTM A307 and installed with ASTM F844 and ASTM A563 nuts. The entire bolt assembly shall be galvanized.

PART 3 EXECUTION

3.1 PREPARATION

Perform complete installation conforming to ASTM F567.

3.1.1 Line and Grade

Install fence to the lines and grades indicated. Clear the area on either side of the fence line to the extent indicated. Space line posts equidistant at intervals not exceeding 10 feet. Set terminal (corner, gate, and pull) posts whenever abrupt changes in vertical and horizontal alignment are encountered. Provide continuous fabric between terminal posts; however, ensure runs between terminal posts do not exceed 500 feet. Repair any damage to galvanized surfaces, including welding, with paint containing zinc dust in accordance with ASTM A780/A780M.

3.1.2 Excavation

Excavate holes to depths indicated. Clear all post holes of loose material and spread waste material where directed. Eliminate ground surface irregularities along the fence line to the extent necessary to maintain a 1 inch clearance between the bottom of the fabric and finish grade.

3.2 INSTALLATION

3.2.1 Installation Drawings

Submit complete Fence Installation Drawings, Vertical Pivot Gate Installation Drawings, and Automatic Sliding Gate Installation Drawings for review and approval by the Contracting Officer prior to shipment. Submit drawing details that include, but are not limited to the following information: Fence Installation Drawings, Location of gate, corner, end, and pull posts, Gate Assembly, Turnstiles, and Gate Hardware and Accessories. Install fence system per approved drawings. Install gate to operator in accordance with gate manufacturer's instructions.

3.2.2 Security Fencing

Install new security fencing, remove existing security fencing, and perform related work to provide continuous security for facility. Schedule and fully coordinate work with Contracting Officer.

3.2.3 Posts

3.2.3.1 Earth and Bedrock

- a. Set posts plumb and in alignment. Except where solid rock is encountered, set posts in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, set posts to a minimum depth of 18 inches in rock. Where solid rock is covered with an overburden of soil or loose rock, set posts to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case terminate depth of penetration. Grout all portions of posts set in rock.
- b. Set portions of posts not set in rock in concrete from the rock to ground level. Set posts in holes not less than the diameter shown on the drawings. Make diameters of holes in solid rock at least 1 inch greater than the largest cross section of the post. Thoroughly consolidate concrete and grout around each post, free of voids and finished to form a dome. Allow concrete and grout to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Set driven posts to a minimum depth of 3 feet and protect with drive caps when setting.
- c. Test fence post rigidity by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground. Ensure post movement measured at the point where the force is applied is less than or equal to 3/4 inch from the relaxed position. Test every tenth post for rigidity. When a post fails this test, make further tests on the next four posts on either side of the failed post. Remove, replace, and retest all failed parts at the Contractor's expense.

3.2.3.2 Concrete Slabs and Walls

When installed in concrete slabs or walls, set posts in zinc-coated sleeves, to a minimum depth of 12 inches. Fill sleeve joint with lead, nonshrink grout, or other approved material. Set posts for support of removable fence sections in sleeves that provide a tight sliding joint and hold posts aligned and plumb without use of lead or setting material.

3.2.4 Rails

Bolt bottom rail to double rail ends and securely fasten double rail ends to the posts. Peen bolts to prevent easy removal. Install bottom rail before chain link fabric. Provide 3/8" diameter eye hook anchored into concrete footing at midpoint.

3.2.5 Fabric

- a. Set fabric height at 8 feet.
- b. Install chain link fabric on the side of the post indicated. Attach fabric to terminal posts with stretcher bars and tension bands. Space bands at approximately 15 inch intervals. Install fabric and pull taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fasten fabric to line posts at approximately 15 inch intervals and fastened to all rails and tension wires at approximately

24 inch intervals.

- c. Cut fabric by untwisting and removing pickets. Accomplish splicing by weaving a single picket into the ends of the rolls to be joined. Install the bottom of the fabric 1 plus or minus 1/2 inch above the ground.
- d. After the fabric installation is complete, exercise the fabric by applying a 50 pound push-pull force at the center of the fabric between posts; use a 30 pound pull at the center of the panel to ensure fabric deflection of not more than 2.5 inches when pulling fabric from the post side of the fence. Every second fence panel is required to meet this requirement. Resecure and retest all failed panels at the Contractor's expense.

3.2.6 Supporting Arms

Install barbed wire supporting arms and barbed wire as indicated on the drawings and as recommended by the manufacturer. Anchor supporting arms to the posts in a manner to prevent easy removal with hand tools. Pull barbed wire taut and attach to the arms with clips or other means that will prevent easy removal.

3.2.7 Barbed Tape Installation

Install stainless steel reinforced barbed tape per ASTM F1911 and as detailed on the drawings. Stretch out barbed tape to its manufacturer's recommended length, set on top of the barbed wire and "V" shaped support arms, then secure it to the barbed wire. Secure the barbed tape to the barbed wire at the two points and at every spiral turn of both coils as shown on the drawings. Install stainless steel reinforced barbed tape for ground applications in accordance with manufacturer's recommendations.

3.2.8 Gate Installation

- a. Install gates at the locations shown. Mount gates to swing outward toward the unsecure side of fencing, as indicated. Install latches, panic bars, stops, and keepers as required and per manufacturer instructions. Install Slide Gates as recommended by the manufacturer. Install Vertical Pivot Gates per manufacturer recommendations. Connect gate to operator in accordance with gate manufacturer's instructions.
- b. Attach padlocks to gates or gate posts with chains. Weld or otherwise secure all latches, hinge pins, and hardware assembly to prevent removal.
- c. Submit 6 copies of operating and maintenance instructions. Outline the step-by-step procedures required for system startup, operation, and shutdown. Include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Include in the maintenance instructions routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. Also include the general gate layout, equipment layout and simplified wiring and control diagrams of the system as installed.

3.2.9 Grounding

- a. Ground fencing and Gates as indicated on drawings or as recommended by the manufacturer.
- b. Ground fences crossed by overhead powerlines in excess of 600 volts and ground all electrical equipment attached to the fence.
- c. Ground fences on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Ensure grounding locations are located no more than 650 feet apart. Bond each gate panel with a flexible bond strap to its gate post. Ground fences crossed by powerlines of 600 volts or more at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing.
- d. Provide ground conductor consisting of No. 8 AWG solid copper wire. Use grounding electrodes that measures 3/4 inch by 10 foot long and are a copper-clad steel rod. Drive electrodes into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, bury electrodes a minimum of 12 inches deep and radially from the fence. Install the top of the electrode to be less than 2 feet or more than 8 feet from the fence. Clamp ground conductor to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. Measure total resistance of the fence to ground and ensure it is not greater than 25 ohms.

3.2.10 Cable Reinforcement Installation

Comply with the contract drawings. Install 2 strands of 3/4 in steel aircraft cables mounted to the chain link fence posts utilizing u-bolts and nuts. Peen the ends of the U-bolts to prevent removal. Tighten cables with galvanized steel turnbuckles with swaged fittings to the point there is no visible sag. Install 3 ft x 3 ft x 1.5 ft concrete deadman anchors which are a minimum of 3 ft underground and installed in undisturbed surrounding soils. Space dead man anchors no more than 200 ft apart and on each side of gate openings. Connect steel aircraft cables to dead man anchors using swaged end fittings and turnbuckles attached to 1.25 in galvanized threaded rod which is embedded into concrete anchor and held in place with two 4 in x 4 in x 1/4 in thick steel plates welded to the threaded rod. Place deadman anchors within 10 feet of last post and on each side of gate openings.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Cleanup

Remove waste fencing materials and other debris from the work site each workday.

-- End of Section --

SECTION 32 92 19

SEEDING

08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C602	(2020) Agricultural Liming Materials
ASTM D4427	(2018) Standard Classification of Peat Samples by Laboratory Testing
ASTM D4972	(2018) Standard Test Methods for pH of Soils

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act
DOA SSIR 42	(1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

1.2 DEFINITIONS

1.2.1 Stand of Turf

95 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 23 00.00 20 EXCAVATION AND FILL, Section 32 93 00 EXTERIOR PLANTS, and Section 32 05 33 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Wood Cellulose Fiber Mulch

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil Composition Tests (reports and recommendations).

SD-07 Certificates

State Certification and Approval for Seed

SD-08 Manufacturer's Instructions

Erosion Control Materials

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer and Lime Storage

Store in cool, dry locations away from contaminants.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 80 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Seed

Apply seed within twenty-four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 LAWN SEED

2.1.1 Classification

Provide State-certified seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected. Field mixes will be acceptable when field mix is performed on site in the presence of the Contracting Officer and Landscape Architect.

2.1.2 Planting Dates

<u>Planting Season</u>	<u>Planting Dates</u>
Spring	April 1st to June 1st
Fall	August 15th to October 1st

2.1.3 Seed Purity

A. LAWN SEED QUALITY

1. Weed Seed: maximum of 0.50%, no noxious weed seed.
2. Purity: minimum 97% pure.
3. Crop: maximum 0.50%.
4. Germination Rate: minimum 80%.

B. SEED MIXTURE (percent by weight):

- 35% Kentucky Bluegrass
- 35% Creeping Red Fescue
- 20% Fiesta 3 Perennial Ryegrass
- 10% Express Perennial Ryegrass

2.1.4 Seed Mixture Application

5 lbs per 1,000 SF

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph COMPOSITION. When available topsoil must be existing surface soil stripped and stockpiled on-site in accordance with Section 31 23 00.00 20 EARTHWORK.

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph COMPOSITION. Additional topsoil must be furnished by the Contractor.

2.2.3 Composition

Containing from 4 to 8 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 1/2 inch, with maximum 3 percent retained on 1/4 inch screen. The pH must be tested in accordance with ASTM D4972. Topsoil must be free of sticks, stones, roots, and other debris and objectionable materials. Soil texture shall meet the USDA Soils Textural Classification percentage of sand, silt and clay for "loam" or "sandy loam" classifications, with not more than 75-percent sand and not less than 5-percent clay. For bidding purposes only percentages shall meet the following:

Silt	7 to 17 percent
Clay	4 to 12 percent
Sand	70 to 82 percent
pH	5.5 to 7.0
Soluble Salts	4.0 mnhos (dS)

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3.1 Lime

Agricultural grade limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C602 of not less than 80 percent.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D4427. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation.

2.3.6 Sand

Clean and free of materials harmful to plants.

2.3.7 Perlite

Horticultural grade.

2.3.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.3.8.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.3.8.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.9 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 80 percent, calcium 18 percent, sulfur 14 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.3.10 Calcined Clay

Calcined clay must be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent must pass a No. 8 sieve; a minimum 99 percent must be retained on a No. 60 sieve; and material passing a No. 100 sieve must not exceed 2 percent. Bulk density: A maximum 40 pounds per cubic foot.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Topsoil Fertilizer: complete at the ratios recommended in the laboratory topsoil test reports.

Starter Fertilizer: guaranteed analysis of 10.20.10 at 10 lbs./1,000 S.F.

Secondary Fertilizer: guaranteed analysis of 15.15.15 at 6.5 lbs./1,000 S.F.

2.4.2 Hydroseeding Fertilizer

Controlled release fertilizer, to use with hydroseeding and composed of pills coated with plastic resin to provide a continuous release of nutrients for at least 6 months.

2.5 MULCH

Mulch must be free from noxious weeds, mold, and other deleterious materials.

2.5.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw must contain no fertile seed.

2.5.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay must be sterile, containing no fertile seed.

2.5.3 Wood Cellulose Fiber Mulch

Use recovered materials of either paper-based (100 percent post-consumer content) or wood-based (100 percent total recovered content) hydraulic mulch. Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 5.5 to 8.0. Use with hydraulic application of grass seed and fertilizer.

2.6 WATER

Source of water must be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

2.7 EROSION CONTROL MATERIALS

Erosion control material must conform to the following:

2.7.1 Erosion Control Blanket

70 percent agricultural straw/30 percent coconut fiber matrix stitched with a degradable netting, designed to degrade within 18 months.

2.7.2 Erosion Control Material Anchors

Erosion control anchors must be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation prior to planting (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all

areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 4 inches of off-site topsoil or on-site topsoil to meet indicated finish grade. When topsoil is placed on existing subgrade, the contractor shall decompact the existing subgrade to a min. of 6". decompacted soil shall be mixed with proposed soil to form a 50-50 soil mix. the amended soil shall be placed to top of subgrade depth. After areas have been brought to indicated finish grade, incorporate fertilizer, pH adjusters and soil conditioners into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 1/2 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.1.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Lime	pH	Rate (LBS.)
	5.0-5.5	100
	5.5-6.0	50
	6.0-6.8	25
	over 6.8	0

Compost: Compost shall be spread over all areas to be sodded at the rate of 10 parts topsoil to 1 part compost.

Superphosphate: Superphosphate shall be applied by machine at the rate of twenty pounds (20 lbs.) per thousand square feet (1,000 s.f.).

Compost: Compost shall be spread over all areas to be seeded at the rate of 10 parts topsoil to 1 part compost.

3.1.1.3 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Organic Granular Fertilizer 20 pounds per 1000 square feet.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

Seeding method must be hydroseeding.

3.2.2.1 Hydroseeding

First, mix water and fiber. Wood cellulose fiber, paper fiber, or recycled paper must be applied as part of the hydroseeding operation. Fiber must be added at 1,000 pounds, dry weight, per acre. Then add and mix seed and fertilizer to produce a homogeneous slurry. Seed must be mixed to ensure broadcasting at the rate recommended by the seed supplier.

When hydraulically sprayed on the ground, material must form a blotter like cover impregnated uniformly with grass seed. Spread with one application with no second application of mulch.

3.2.3 Erosion Control Material

Install in accordance with manufacturer's instructions, where indicated or as directed by the Contracting Officer.

3.2.4 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

SECTION 32 93 00

EXTERIOR PLANTS

08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICANHORT (AH)

ANSI/ANLA Z60.1 (2004) American Standard for Nursery Stock

ASTM INTERNATIONAL (ASTM)

ASTM C602 (2020) Agricultural Liming Materials

ASTM D4427 (2018) Standard Classification of Peat Samples by Laboratory Testing

ASTM D4972 (2018) Standard Test Methods for pH of Soils

ASTM D5268 (2019) Topsoil Used for Landscaping Purposes

ASTM D5852 (2000; R 2007; E 2014) Standard Test Method for Erodibility Determination of Soil in the Field or in the Laboratory by the Jet Index Method

ASTM D6629 (2001; R 2012; E 2012) Selection of Methods for Estimating Soil Loss by Erosion

L.H. BAILEY HORTORIUM (LHBH)

LHBH (1976) Hortus Third

TREE CARE INDUSTRY ASSOCIATION (TCIA)

TCIA A300P1 (2017) ANSI A300 Part1: Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance Standard Practices - Pruning

TCIA Z133 (2017) American National Standard for Arboricultural Operations - Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush - Safety Requirements

U.S. DEPARTMENT OF AGRICULTURE (USDA)

DOA SSIR 42 (1996) Soil Survey Investigation Report

No. 42, Soil Survey Laboratory Methods
Manual, Version 3.0

1.2 RELATED REQUIREMENTS

Section 31 23 00.00 20 EXCAVATION AND FILL, Section 32 92 19 SEEDING, and Section 32 05 33 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

State Landscape Contractor's License

Time Restrictions and Planting Conditions

Indicate anticipated dates and locations for each type of planting.

SD-03 Product Data

Peat

Composted Derivatives

Rotted Manure

Gypsum

Mulch; G

Ground Stakes

Concrete Edging

Fertilizer

Weed Control Fabric; G

Root Control Barrier; G

Staking Material

Antidesiccants

Erosion Control Materials

Photographs; G

SD-04 Samples

Mulch; G

Submit one gallon of mulch.

SD-06 Test Reports

Topsoil Composition Tests; Soil Test of current growing area; Soil Test of proposed area; Soil Test location map

Percolation Test; Percolation Test of proposed planting areas scarification and decompaction of subsoils occur.

SD-07 Certificates

Nursery Certifications

SD-10 Operation and Maintenance Data

Plastic Identification

When not labeled, identify types in Operation and Maintenance Manual.

1.4 QUALITY ASSURANCE

1.4.1 Topsoil Composition Tests

Commercial test from an independent testing laboratory including basic soil groups (moisture and saturation percentages, Nitrogen-Phosphorus-Potassium (N-P-K) ratio, pH (ASTM D4972), soil salinity), secondary nutrient groups (calcium, magnesium, sodium, Sodium Absorption Ratio (SAR)), micronutrients (zinc, manganese, iron, copper), toxic soil elements (boron, chloride, sulfate), cation exchange and base saturation percentages, and soil amendment and fertilizer recommendations with quantities for plant material being transplanted. Soil required for each test must include a maximum depth of 18 inches of approximately one quart volume for each test. Areas sampled should not be larger than one acre and should contain at least 6-8 cores for each sample area and be thoroughly mixed. Problem areas should be sampled separately and compared with samples taken from adjacent non-problem areas. The location of the sample areas should be noted and marked on a parcel or planting map for future reference.

1.4.2 Nursery Certifications

- a. Indicate on nursery letterhead the name of plants in accordance with the LHBH, including botanical common names, quality, and size.
- b. Inspection certificate.
- c. Mycorrhizal fungi inoculum for plant material treated

1.4.3 State Landscape Contractor's License

Construction company must hold a landscape contractors license in the state where the work is performed and have a minimum of five years landscape construction experience. Submit copy of license and three references for similar work completed in the last five years.

1.4.4 Plant Material Photographs

Contractor must submit nursery photographs, for government approval prior to ordering, for each tree larger than 24-inch box/ 2-inch caliper size.

1.4.5 Percolation Test

Immediately following rough grading operation, identify a typical location for one of the largest trees and or shrubs and excavate a pit per the project details. Fill the pit with water to a depth of 12 inches. The length of time required for the water to percolate into the soil, leaving the pit empty, must be measured by the project Civil Engineer and verified by the Contracting Officer. Within six hours of the time the water has drained from the pit, the Contractor, with the Contracting Officer and project Landscape Architect present, must again fill the pit with water to a depth of 12 inches. If the water does not completely percolate into the soil within 9 hours, a determination must be made whether a drainage system or a soil penetrant will be required for each tree and or shrub being transplanted.

1.4.6 Erosion Assessment

Assess potential effects of soil management practices on soil loss in accordance with ASTM D6629. Assess erodibility of soil with dominant soil structure less than 2.8 to 3.1 inches in accordance with ASTM D5852.

1.4.7 Pre-Installation Meeting

Convene a pre-installation meeting a minimum of one week prior to commencing work of this section. Require attendance of parties directly affecting work of this section. Review conditions of operations, procedures and coordination with related work. Agenda must include the following:

- a. Tour, inspect, and discuss conditions of planting materials.
- b. Review planting schedule and maintenance.
- c. Review required inspections.
- d. Review environmental procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Branched Plant Delivery

Deliver with branches tied and exposed branches covered with material which allows air circulation. Prevent damage to branches, trunks, root systems, and root balls and desiccation of leaves.

1.5.1.2 Soil Amendment Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer, gypsum, sulfur, iron, and lime may be furnished in bulk with a certificate indicating the above information. Store in dry

locations away from contaminates.

1.5.1.3 Plant Labels

Deliver plants with durable waterproof labels in weather-resistant ink. Provide labels stating the correct botanical and common plant name and variety as applicable and size as specified in the list of required plants. Attach to plants, bundles, and containers of plants. Groups of plants may be labeled by tagging one plant. Labels must be legible for a minimum of 60 days after delivery to the planting site.

1.5.2 Storage

1.5.2.1 Plant Storage and Protection

Store and protect plants not planted on the day of arrival at the site as follows:

- a. Shade and protect plants in outside storage areas from the wind and direct sunlight until planted.
- b. Heel-in bare root plants.
- c. Protect balled and burlapped plants from freezing or drying out by covering the balls or roots with moist burlap, sawdust, wood chips, shredded bark, peat moss, or other approved material. Provide covering which allows air circulation.
- d. Keep plants in a moist condition until planted by watering with a fine mist spray.
- e. Do not store plant material directly on concrete or bituminous surfaces.
- f. Plants stored onsite for any period of time after delivery to the site shall be inspected prior to installation. Plants found to show signs of decline shall be replaced with new plant stock and rejected from being planted.

1.5.2.2 Fertilizer, Gypsum, pH Adjusters and Mulch Storage

Store in dry locations away from contaminants.

1.5.2.3 Topsoil

Prior to stockpiling topsoil, eradicate on site undesirable growing vegetation. Clear and grub existing vegetation three to four weeks prior to stockpiling existing topsoil.

1.5.2.4 Root Control Barrier and Weed Control Fabric

Store materials on site in enclosures or under protective covering in dry location. Store under cover out of direct sunlight. Do not store materials directly on ground.

1.5.3 Handling

Do not drop or dump plants from vehicles. Avoid damaging plants being moved from nursery or storage area to planting site. Handle balled and

burlapped and container plants carefully to avoid damaging or breaking the earth ball or root structure. Do not handle plants by the trunk or stem. Remove damaged plants from the site.

1.5.4 TIME LIMITATION

Except for container-grown plant material, the time limitation from digging to installing plant material must be a maximum of 90 days. The time limitation between installing the plant material and placing the mulch must be a maximum of 24 hours.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

Coordinate installation of planting materials during optimal planting seasons for each type of plant material required.

1.6.1 Planting Dates

Plant all plants from in timeframes indicated below.

1.6.1.1 Deciduous Material

Deciduous material from April 1st to May 15th for spring planting and from September 1st to October 15th for fall planting.

1.6.1.2 Evergreen Material

Evergreen material from April 1st to May 15th for spring planting and from September 1st to October 15th for fall planting.

1.6.2 Restrictions

Do not plant when ground is frozen, snow covered, muddy, there is standing water, or when air temperature exceeds 80 degrees Fahrenheit

Do not plant when outside of the recommended planting times for deciduous or evergreen planting material unless written authorization is provided by the Contracting officer and the Landscape Architect.

1.7 GUARANTEE

All plants must be guaranteed for one year beginning on the date of inspection and written acknowledgement of substantial completion by the Contracting Officer to commence the plant establishment period, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by the Government or by weather conditions unusual for the warranty period.

Remove and replace dead planting materials immediately unless required to plant in the succeeding planting season. At end of warranty period, replace planting materials that die or have 25 percent or more of their branches that die during the construction operations or the guarantee period.

1.8 PLASTIC IDENTIFICATION

Provide product data indicating polymeric information in Operation and Maintenance Manual.

Type 1: Polyethylene Terephthalate (PET, PETE).

Type 2: High Density Polyethylene (HDPE).
Type 3: Vinyl (Polyvinyl Chloride or PVC).
Type 4: Low Density Polyethylene (LDPE).
Type 5: Polypropylene (PP).
Type 6: Polystyrene (PS).
Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

PART 2 PRODUCTS

2.1 PLANTS

2.1.1 Regulations and Varieties

Existing trees and shrubs to remain must be protected and a planting plan be arranged around them. Furnish nursery stock in accordance with ANSI/ANLA Z60.1, except as otherwise specified or indicated. Each plant or group of planting must have a "key" number indicated on the nursery certifications of the plant schedule. Furnish plants, including turf grass, grown under climatic conditions similar to those in the locality of the project. Plants specified must be indigenous, low maintenance varieties, tolerant of site's existing soils and climate without supplemental irrigation or fertilization once established. Spray plants budding into leaf or having soft growth with an antidesiccant before digging. Plants of the same specified size must be of uniform size and character of growth. Plants must be chosen with their mature size and growth habit in mind to avoid over-planting and conflict with other plants, structures, or underground utility lines. All plants must comply with all Federal and State Laws requiring inspection for plant diseases and infestation.

2.1.2 Shape and Condition

Well-branched, well-formed, sound, vigorous, healthy planting stock free from disease, sunscald, windburn, abrasion, and harmful insects or insect eggs and having a healthy, normal, and undamaged root system.

2.1.2.1 Deciduous Trees and Shrubs

Symmetrically developed and of uniform habit of growth, with straight boles or stems, and free from objectionable disfigurements.

2.1.2.2 Evergreen Trees and Shrubs

Well-developed symmetrical tops with typical spread of branches for each particular species or variety.

2.1.2.3 Ground Covers and Vines

Number and length of runners and clump sizes indicated, and of the proper age for the grade of plants indicated, furnished in removable containers, integral containers, or formed homogeneous soil section.

2.1.3 Plant Size

Minimum sizes measured after pruning and with branches in normal position, must conform to measurements indicated, based on the average width or

height of the plant for the species as specified in ANSI/ANLA Z60.1. Plants larger in size than specified may be provided with approval of the Contracting Officer and Landscape Architect. When larger plants are provided, increase the ball of earth, or spread of roots in accordance with ANSI/ANLA Z60.1.

2.1.1.4 Root Ball Size

All box-grown, field potted, field boxed, collected, plantation grown, bare root, balled and burlapped, container grown, processed-balled, and in-ground fabric bag-grown root balls must conform to ANSI/ANLA Z60.1. All wrappings and ties must be biodegradable. Root growth in container grown plants must be sufficient to hold earth intact when removed from containers. Root bound plants will not be accepted.

2.1.1.4.1 Mycorrhizal fungi inoculum

Before shipment, root systems must contain mycorrhizal fungi inoculum.

2.1.1.5 Growth of Trunk and Crown

2.1.1.5.1 Deciduous Trees

A height to caliper relationship must be provided in accordance with ANSI/ANLA Z60.1. Height of branching must bear a relationship to the size and species of tree specified and with the crown in good balance with the trunk. The trees must not be "poled" or the leader removed.

- a. Single stem: The trunk must be reasonably straight and symmetrical with crown and have a persistent main leader.
- b. Multi-stem: All countable stems, in aggregate, must average the size specified. To be considered a stem, there must be no division of the trunk which branches more than 6 inches from ground level.

2.1.1.5.2 Deciduous Shrubs

Deciduous shrubs must have the height and number of primary stems recommended by ANSI/ANLA Z60.1. Acceptable plant material must be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

2.1.1.5.3 Coniferous Evergreen Plant Material

Coniferous Evergreen plant material must have the height-to-spread ratio recommended by ANSI/ANLA Z60.1. The coniferous evergreen trees must not be "poled" or the leader removed. Acceptable plant material must be exceptionally heavy, well-shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired must be as indicated.

2.1.1.5.4 Broadleaf Evergreen Plant Material

Broadleaf evergreen plant material must have the height-to-spread ratio recommended by ANSI/ANLA Z60.1. Acceptable plant material must be well shaped and recognized by the trade as typical for the variety grown in the region of the project.

2.1.5.5 Ground Cover and Vine Plant Material

Ground cover and vine plant material must have the minimum number of runners and length of runner recommended by ANSI/ANLA Z60.1. Plant material must have heavy, well developed, and balanced crown with vigorous, well developed root system and must be furnished in containers.

2.2 TOPSOIL

2.2.1 Existing Soil

Modify to conform to requirements specified in paragraph COMPOSITION.

2.2.2 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph COMPOSITION. When available topsoil must be existing surface soil stripped and stockpiled on-site in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

2.2.3 Off-Site Topsoil

Conform to requirements specified in paragraph COMPOSITION. Additional topsoil must be furnished by the Contractor and meet the criteria outlined herein.

2.2.4 Composition

Evaluate soil for use as topsoil in accordance with ASTM D5268. From 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 1/2 inch, with maximum 3 percent retained on 1/4 inch screen. The pH must be tested in accordance with ASTM D4972. Topsoil must be free of sticks, stones, roots, plants, and other deleterious materials or debris and objectionable materials. Topsoil shall meet the USDA Textural Classification percentages of sand, silt and clay for "sandy loam" or "fine sandy loam" classifications. Other components must conform to the following limits:

Silt	7 to 17 percent
Clay	4 to 12 percent
Sand	70 to 82 percent
pH	5.5 to 7.0
Soluble Salts	4.0 mnhos (dS)

2.3 SOIL CONDITIONERS

Provide singly or in combination as required to meet specified requirements for topsoil. Soil conditioners must be nontoxic to plants.

2.3.1 Lime

Commercial grade agricultural limestone containing a calcium carbonate

equivalent (C.C.E.) as specified in ASTM C602 of not less than 80 percent.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D4427 as modified herein. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation. Peat must not contain invasive species, including seeds.

2.3.6 Sand

Clean and free of materials harmful to plants.

2.3.7 Perlite

Horticultural grade.

2.3.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus, or other green wood waste material free of stones, sticks, invasive species, including seeds, and soil stabilized with nitrogen and having the following properties:

2.3.8.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.3.8.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.9 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 80 percent, calcium 18 percent, sulfur 14 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.3.10 Vermiculite

Horticultural grade for planters.

2.3.11 Rotted Manure

Well-rotted horse or cattle manure containing maximum 25 percent by volume of straw, sawdust, or other bedding materials; free of seeds, stones, sticks, soil, and other invasive species.

2.4 PLANTING SOIL MIXTURES

Topsoil as specified herein, whether using onsite stockpiled topsoil, or borrow topsoil and amended as recommended by the Topsoil Test Report. Topsoil shall be amended and thoroughly and uniformly blended to meet the optimum nutrient levels specified in the Topsoil Test Report.

2.5 FERTILIZER

Fertilizer for groundcover, wildflowers and grasses is not permitted. Fertilizer for trees, plants, and shrubs must be as recommended by plant supplier, except synthetic chemical fertilizers are not permitted. Fertilizers containing petrochemical additives or that have been treated with pesticides or herbicides are not permitted.

2.5.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

- 4 percent available nitrogen
- 4 percent available phosphorus
- 4 percent available potassium

2.6 WEED CONTROL FABRIC

2.6.1 Roll Type Polypropylene or Polyester Mats

Fabric must be woven, needle punched or non-woven and treated for protection against deterioration due to ultraviolet radiation. Fabric must be minimum 99 percent opaque to prevent photosynthesis and seed germination from occurring, yet allowing air, water and nutrients to pass thru to the roots. Minimum weight must be 5 ounces per square yard with a minimum thickness of 20 mils with a 20 year (minimum) guarantee.

2.7 MULCH

Free from noxious weeds, mold, pesticides, or other deleterious materials.

2.8 STAKING MATERIAL

2.8.1 Staking Material

2.8.1.1 Tree Support Stakes

Rough sawn hard wood free of knots, rot, cross grain, bark, long slivers, or other defects that impair strength. Stakes must be minimum 2 inches square or 2-1/2 inch diameter by 8 feet long, pointed at one end.

2.8.1.2 Ground Stakes

Rough sawn hard wood or plastic, 2 inches square are by 3 feet long, pointed at one end.

2.8.2 Hose Chafing Guards

New or used 2 ply 3/4 inch diameter reinforced rubber or plastic hose, black or dark green, all of same color.

2.8.3 Turnbuckles

Galvanized or cadmium-plated steel with minimum 3-inch-long openings fitted with screw eyes. Eye bolts must be galvanized or cadmium-plated steel with one inch diameter eyes and screw length 1-1/2 inches, minimum.

2.9 EDGING MATERIAL

2.9.1 Concrete Edging

Cast-in-place 6 by 6 inch concrete mowstrip. Provide saw cut contraction joints to a depth of 3/4 inch after the surface has been finished. Provide joints every 20 lineal feet. Provide 1/2 inch thick expansion joints at change of direction and where mowstrip abuts rigid pavement. Provide #4 reinforcement bar and other devices necessary to install and secure reinforcement. Provide a floated finish, then finish with a flexible bristle broom. 3000 psi compressive concrete strength at 28 days as specified under Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.10 ANTIDESICCANTS

Sprayable, water insoluble vinyl-vinledine complex which produce a moisture retarding barrier not removable by rain or snow. Film must form at temperatures commonly encountered out of doors during planting season and have a moisture vapor transmission rate (MVT) of the resultant film of maximum 10 grams per 24 hours at 70 percent humidity.

2.11 EROSION CONTROL MATERIALS

Erosion control material must conform to the following:

2.11.1 Erosion Control Blanket

70 percent agricultural straw/30 percent coconut fiber matrix stitched with a degradable netting, designed to degrade within 18 months.

2.11.2 Erosion Control Material Anchors

Erosion control anchors must be as recommended by the manufacturer.

2.12 ROOT CONTROL BARRIER

Pre-formed, linear barrier with integral vertical root deflecting ribs constructed of ultraviolet resistant polypropylene material. Color to be black.

2.13 WATER

Source of water to be approved by Contracting Officer and suitable quality for irrigation and must not contain elements toxic to plant life, including acids, alkalis, salts, chemical pollutants, and organic matter. Use collected storm water or graywater when available.

2.14 MYCORRHIZAL FUNGI INOCULUM

Mycorrhizal fungi inoculum must be composed of multiple-fungus inoculum as recommended by the manufacturer for the plant material specified.

2.15 SOURCE QUALITY CONTROL

The Contracting Officer Landscape Architect of Record will inspect and tag plant materials at the nursery site and approve them. Tag plant materials for size and quality.

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide soil preparation, including soil conditioners and soil amendments prior to planting. Provide tree, shrub, groundcover, and seed, planting, post-planting fertilizer, edging, staking, guying, weed control fabric, erosion control material, root control barrier installation, and mulch topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.2 PREPARATION

3.2.1 Protection

Protect existing and proposed landscape features, elements, and sites from damage or contamination. Protect trees, vegetation, and other designated features by erecting high-visibility, reusable construction fencing. Locate fence no closer to trees than the drip line. Plan equipment and vehicle access to minimize and confine soil disturbance and compaction to areas indicated on Drawings.

3.2.2 Layout

Stake out approved plant material locations and planter bed outlines on the project site before digging plant pits or beds. The Contracting Officer reserves the right to adjust plant material locations to meet field conditions. Do not plant closer than 12 inches to a building wall, and other similar structures. Provide on-site locations for excavated rock, soil, and vegetation.

3.2.3 Erosion Control

Provide erosion control and seeding with native plant species to protect slopes.

3.2.4 Soil Preparation

3.2.4.1 pH Adjuster Application Rates

Apply pH adjuster at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Lime 100 pounds per 1000 square feet

Sulfur 50 pounds per 1000 square feet

Iron 100 pounds per 1000 square feet

Aluminum Sulfate 100 pounds per 1000 square feet

3.2.4.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Peat 3 cubic yards per 1000 square feet

Sand 3 cubic yards per 1000 square feet

Compost Derivatives 3 cubic yards per 1000 square feet

Gypsum 3 cubic yards per 1000 square feet

Rotted Manure 3 cubic yards per 1000 square feet

3.2.4.3 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Topsoil Fertilizer: complete at the ratios recommended in the laboratory topsoil test reports.

Starter Fertilizer: guaranteed analysis of 10.20.10 at 10 lbs./1,000 S.F.

Secondary Fertilizer: guaranteed analysis of 15.15.15 at 6.5 lbs./1,000 S.F.

3.2.5 Root Control Barrier

Install polypropylene barrier in the soil in a vertical application. Use appropriate holding device to assure barrier position and appropriate device to connect two pieces. For vertical application, install root barrier 1" above finished grade. A minimum 18 inch extension of barrier beyond the structure area to be protected is required to prevent root growth from growing around barrier edges.

3.3 PLANT BED PREPARATION

Verify location of underground utilities prior to excavation. Protect existing adjacent turf before excavations are made. Do not disturb topsoil and vegetation in areas outside those indicated on Drawings. Where planting beds occur in existing turf areas, remove turf to a depth that will ensure removal of entire root system. Measure depth of plant pits from finished grade. Depth of plant pit excavation must be as indicated and provide proper relation between top of root ball and finished grade. Install plant material as specified in paragraph PLANT INSTALLATION. Do not install trees within 10 feet of any utility lines or building walls.

3.4 PLANT INSTALLATION

3.4.1 Individual Plant Pit Excavation

Excavate pits at least twice as large in diameter as the size of ball or container to depth shown.

3.4.2 Plant Beds with Multiple Plants

Excavate plant beds continuously throughout entire bed as outlined to depth shown.

3.4.3 Handling and Setting

Move plant materials only by supporting the root ball container. Set plants on existing or recompact existing soil and hold plumb in the center of the pit until soil has been tamped firmly around root ball. Set plant materials, in relation to surrounding finish grade, so that the root flare will not be buried, and equal to the depth at which they were grown in the nursery, collecting field or container. Replace plant material whose root balls are cracked or damaged either before or during the planting process.

Plant material must be set in plant beds according to the drawings. Backfill soil mixture must be placed on previously scarified subsoil to completely surround the root balls, and must be brought to a smooth and even surface, blending to existing areas.

3.4.3.1 Balled and Burlapped Stock

Backfill with topsoil to approximately half the depth of ball and then tamp and water. Carefully remove or fold back excess burlap and tying materials from the top a minimum 1/3 depth from the top of the rootball. Tamp and complete backfill, place mulch topdressing, and water. Remove wires and non-biodegradable materials from plant pit prior to backfill operations.

3.4.3.2 Container Grown Stock

Remove from container and prevent damage to plant or root system.

3.4.3.3 Ground Covers and Vines

Smooth planting areas before planting to provide even, smooth finish. Plant after placing weed control fabric and mulch topdressing. Do not remove plant material from flats or containers until immediately before planting. Space at the intervals indicated. Plant at a depth to sufficiently cover all roots. Start watering areas planted as required by temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to a depth of 6 inches without run off or puddling. Add mulch topdressing as needed.

3.4.4 Earth Mounded Watering Basin for Individual Plant Pits

Form with topsoil around each plant by replacing a mound of topsoil around the edge of each plant pit. Watering basins must be 6 inches deep for trees and 4 inches deep for shrubs. Eliminate basins around plants in plant beds containing multiple plants.

3.4.5 Weed Control Fabric Installation

Remove grass and weed vegetation, including roots, from within the area enclosed by edging. Completely cover areas enclosed by edging with specified weed control fabric prior to placing mulch layer. Overlap cut edges 12 inches.

3.4.6 Erosion Control Material

Install in accordance with manufacturer's instructions.

3.4.7 Placement of Mulch Topdressing

Place specified mulch topdressing on top of weed control fabric covering total area enclosed by edging. Place mulch topdressing to a depth of 4 inches.

3.4.8 Mulch Topdressing

Provide mulch topdressing over entire planter bed surfaces and individual plant surfaces including earth mound watering basin around plants to a depth of 4 inches after completion of plant installation and before watering. Keep mulch out of the crowns of shrubs. Place mulch a minimum 2 to 3 inches away from root flare/trunk of shrub or tree and at a depth of no more than 1". Place on top of any weed control fabric.

3.4.9 Installation of Edging

Uniformly edge beds of plants to provide a clear cut division line between planted area and adjacent lawn. Construct bed shapes as indicated. Install concrete edging material as indicated. Install edging with minimum one inch left above ground level.

3.4.10 Fertilization

3.4.10.1 Granular Fertilizer

Apply granular fertilizer as a top coat prior to placing mulch layer and water thoroughly.

3.4.11 Watering

Start watering areas planted as required by temperature and wind conditions. Slow deep watering must be used. Apply water at a rate sufficient to ensure thorough wetting of soil to a depth of 12 - 18 inches without run off or puddling. Watering of other plant material or adjacent areas must be prevented.

3.4.12 Staking and Guying

3.4.12.1 Staking

Stake plants with the number of stakes indicated complete with 32" long non-abrasive rubber ties as detailed. Attach rubber ties half the tree height but not more than 5 feet high. Drive stakes to a depth of 2 feet into the ground outside the plant pit. Do not injure the root ball.

3.4.13 Pruning

Prune in accordance with safety requirement of TCIA Z133.

3.4.13.1 Trees and Shrubs

Remove dead and broken branches. Prune to correct structural defects only. Retain typical growth shape of individual plants with as much height and spread as practical. Do not cut central leader on trees. Make cuts with sharp instruments. Do not flush cut with trunk or adjacent branches. Collars must remain in place. Pruning must be accomplished by trained and experienced personnel and must be accordance with TCIA A300P1.

3.4.13.2 Wound Dressing

Do not apply tree wound dressing to cuts.

3.5 RESTORATION AND CLEAN UP

3.5.1 Restoration

Turf areas, pavements and facilities that have been damaged from the planting operation must be restored to original condition at the Contractor's expense.

3.5.2 Clean Up

Excess and waste material must be removed from the installed area and must be disposed offsite at an approved landfill, recycling center, or composting center. Separate and recycle or reuse the following landscape waste materials: nylon straps, wire, ball wrap, burlap, wood stakes. Adjacent paved areas must be cleared.

-- End of Section --

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SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING
02/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B1.20.3	(1976; R 2013) Dryseal Pipe Threads (Inch)
ASME B16.1	(2015) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.5.2.1M	(2006; R 2011) Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	(1982; R 2010) Metric Round Head Square Neck Bolts

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2018) Hypochlorites
AWWA B301	(2010) Liquid Chlorine
AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2020) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C150/A21.50	(2014) Thickness Design of Ductile-Iron

Pipe

AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA C153/A21.53	(2019) Ductile-Iron Compact Fittings for Water Service
AWWA C213	(2015) Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
AWWA C219	(2017) Bolted Sleeve-Type Couplings for Plain-End Pipe
AWWA C500	(20019) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(2018) Dry-Barrel Fire Hydrants
AWWA C508	(2017) Swing-Check Valves for Waterworks Service, 2 In. Through 48-In. (50-mm Through 1,200-mm) NPS
AWWA C509	(2015) Resilient-Seated Gate Valves for Water Supply Service
AWWA C515	(2015) Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
AWWA C550	(2017) Protective Interior Coatings for Valves and Hydrants
AWWA C600	(2017) Installation of Ductile-Iron Mains and Their Appurtenances
AWWA C605	(2014) Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C651	(2014) Standard for Disinfecting Water Mains
AWWA C655	(2009) Field Dechlorination
AWWA C800	(2014) Underground Service Line Valves and Fittings
AWWA M6	(2012) Water Meters - Selection, Installation, Testing, and Maintenance
AWWA M9	(2008; Errata 2013) Manual: Concrete Pressure Pipe
AWWA M23	(2020) Manual: PVC Pipe - Design and Installation - Third Edition
AWWA M41	(2009; 3rd Ed) Ductile-Iron Pipe and

Fittings

AWWA M55 (2006) PE Pipe - Design and Installation

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M (1999; R 2018; E 2018) Standard
Specification for Ferritic Malleable Iron
Castings

ASTM A48/A48M (2003; R 2016) Standard Specification for
Gray Iron Castings

ASTM A307 (2014; E 2017) Standard Specification for
Carbon Steel Bolts, Studs, and Threaded
Rod 60 000 PSI Tensile Strength

ASTM A536 (1984; R 2019; E 2019) Standard
Specification for Ductile Iron Castings

ASTM A563 (2015) Standard Specification for Carbon
and Alloy Steel Nuts

ASTM B32 (2008; R 2014) Standard Specification for
Solder Metal

ASTM B61 (2015) Standard Specification for Steam or
Valve Bronze Castings

ASTM B62 (2017) Standard Specification for
Composition Bronze or Ounce Metal Castings

ASTM B88 (2020) Standard Specification for Seamless
Copper Water Tube

ASTM C94/C94M (2020) Standard Specification for
Ready-Mixed Concrete

ASTM D2774 (2012) Underground Installation of
Thermoplastic Pressure Piping

ASTM D2855 (2015) Standard Practice for Making
Solvent-Cemented Joints with Poly(Vinyl
Chloride) (PVC) Pipe and Fittings

ASTM F402 (2005; R 2012) Safe Handling of Solvent
Cements, Primers, and Cleaners Used for
Joining Thermoplastic Pipe and Fittings

ASTM F2164 (2018) Standard Practice for Field Leak
Testing of Polyethylene (PE) and
Crosslinked Polyethylene (PEX) Pressure
Piping Systems Using Hydrostatic Pressure

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA TRD ((2016) Thrust Restraint Design for
Ductile Iron Pipe

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH
(FCCCHR)

FCCCHR Manual (10th Edition) Manual of Cross-Connection
Control

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-80 (2019) Bronze Gate, Globe, Angle and Check
Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24 (2019; TIA 19-1) Standard for the
Installation of Private Fire Service Mains
and Their Appurtenances

NSF INTERNATIONAL (NSF)

NSF 372 (2016) Drinking Water System Components -
Lead Content

NSF/ANSI 61 (2020) Drinking Water System Components -
Health Effects

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01 (2016; with Change 3, 2019) Fire
Protection Engineering for Facilities

UNDERWRITERS LABORATORIES (UL)

UL 246 (2011; Reprint Jul 2020) UL Standard for
Safety Hydrants for Fire-Protection Service

UL 262 (2004; Reprint Oct 2011) Gate Valves for
Fire-Protection Service

UL 312 (2010; Reprint Mar 2018) UL Standard for
Safety Check Valves for Fire-Protection
Service

1.2 DEFINITIONS

1.2.1 Water Transmission Mains

Water transmission mains include water piping having diameters greater than 14 inch, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.2 Water Mains

Water mains include water piping having diameters 4 through 14 inch, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.3 Water Service Lines

Water service lines include water piping from a water main to a building service at a point approximately 5 feet from building or the point indicated on the drawings, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.4 Additional Definitions

For additional definitions refer to the definitions in the applicable referenced standard.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Connections; G

SD-03 Product Data

Pipe, Fittings, Joints and Couplings; G

Valves; G

Valve Boxes; G

Indicator Posts; G

Fire Hydrants; G

Pipe Restraint; G

Tapping Sleeves; G

Mechanical Couplings; G

Insulating Joints; G

Tracer Wire; G

Corporation Stops; G

Tapping Saddles; G

Backflow Preventor; G

Disinfection Procedures; G

Compound Type Meters

SD-06 Test Reports

Bacteriological Samples; G

Hydrostatic Sewer Test

Leakage Test

Hydrostatic Test

Backflow Preventer Tests

SD-07 Certificates

Pipe, Fittings, Joints and Couplings

Lining

Valves

Fire Hydrants

SD-08 Manufacturer's Instructions

Ductile Iron Piping

Polyethylene (PE) Pipe

Copper Pipe For Service Lines

1.4 QUALITY CONTROL

1.4.1 Regulatory Requirements

Comply with NSF/ANSI 61 and NSF 372 for materials for potable water systems; comply with lead content requirements for "lead-free" plumbing as defined by the U.S. Safe Drinking Water Act effective January 2014. Provide materials bearing the seal of the National Sanitation Foundation (NSF) for potable water service.

Comply with NFPA 24 for materials, installation, and testing of fire main piping and components.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling and in accordance with manufacturer's instructions. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves, fire hydrants, and other accessories free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, fire hydrants, and other accessories in accordance with manufacturer's instructions and in a manner to ensure delivery to the trench in sound undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or

linings are damaged. Do not place other material, hooks, or pipe inside a pipe or fitting after the coating has been applied. Inspect the pipe for defects before installation. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. Clean the interior of pipe and accessories of foreign matter before being lowered into the trench and keep them clean during laying operations by plugging. Replace defective material without additional expense to the Government. Store rubber gaskets, not immediately installed, under cover or out of direct sunlight.

Handle ductile iron pipe, fittings, and accessories in accordance with AWWA C600 and AWWA M41. Handle PVC and PVC0 pipe, fittings, and accessories in accordance with AWWA C605. Handle PE pipe, fittings, and accessories in accordance with AWWA M55.

PART 2 PRODUCTS

2.1 MATERIALS

Provide all materials in accordance with AWWA C800 and as indicated herein. Provide valves and fittings with pressure ratings equivalent to the pressure ratings of the pipe.

2.1.1 Pipe, Fittings, Joints And Couplings

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

2.1.1.1 Ductile-Iron Piping

2.1.1.1.1 Pipe and Fittings

Pipe, AWWA C151/A21.51, Thickness Class 52 per AWWA C150/A21.50. Flanged pipe, AWWA C115/A21.15. Fittings, AWWA C153/A21.53; fittings with push-on joint ends are to meet the same requirements as fittings with mechanical-joint ends, except for the factory modified bell design. Provide fittings with pressure ratings equivalent to that of the pipe. Provide compatible pipe ends and fittings for the specified joints. Provide cement-mortar lining, AWWA C104/A21.4, twice the standard thickness on pipe and fittings.

2.1.1.1.2 Joints and Jointing Material

Provide push-on joints or mechanical joints for pipe and fittings unless otherwise indicated. Provide mechanical joints where indicated. Provide flanged joints where indicated. Provide mechanically coupled type joints using a sleeve-type mechanical coupling where indicated. Sleeve-type mechanical couplings in lieu of push-on joints are acceptable, subject to the limitations specified in the paragraph SLEEVE-TYPE MECHANICAL COUPLINGS.

- a. Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly as recommended in AWWA C111/A21.11.
- b. Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets as recommended in AWWA C111/A21.11.

- c. Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in Appendix A of AWWA C115/A21.15. Provide AWWA C115/A21.15 ductile iron flanges and conform to ASME B16.1, Class 125. Provide ASTM A536 epoxy coated steel set screw flanges. Gasket and lubricants for set screw flanges, in accordance with mechanical-joint gaskets specified in AWWA C111/A21.11.
- d. Insulating Joints: Designed to prevent metal-to-metal contact at the joint between adjacent sections of piping. Provide flanged type joint with insulating gasket, insulating bolt sleeves, and insulating washers. Provide full face dielectric type gaskets, as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts, as recommended in the Appendix to AWWA C115/A21.15.
- e. Sleeve-Type Mechanical Coupled Joints: As specified in the paragraph SLEEVE-TYPE MECHANICAL COUPLINGS.

2.1.1.2 Plastic Piping

2.1.1.2.1 Polyethylene (PE) Pipe For Service Lines

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation (NSF) for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

- a. Polyethylene (PE) Plastic Pipe: Pipe tubing, and heat fusion fitting shall conform to AWWA C901.
- b. Polyethylene tubing (PET) shall be ultra high molecular weight polyethylene, rated for 200 psi and conforming to AWWA C901.

2.1.1.3 Copper Pipe For Service Lines

2.1.1.3.1 Copper Tubing and Associated Fittings

Provide ASTM B88, Type K copper tubing. Provide AWWA C800 fittings. AWWA C800 includes ASME B1.20.3, ASME B1.20.1, ASME B16.18 solder-type joint fittings.

2.1.2 Valves

Provide a protective interior coating in accordance with AWWA C550.

2.1.2.1 Gate Valves 3 Inch Size and Larger

AWWA C500, AWWA C509, AWWA C515, or UL 262 and:

- a. AWWA C515: nonrising stem type with mechanical-joint ends or resilient-seated gate valves 3 to 12 inches in size
- b. UL 262: inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 200 psi, and have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined.

Match materials for UL 262 gate valves to the reference standards specified in AWWA C500. Gate valves open by counterclockwise rotation of the valve stem. Stuffing boxes have O-ring stem seals. Stuffing boxes

are bolted and constructed so as to permit easy removal of parts for repair. Where an indicator post are shown, provide an indicator post flange for AWWA C515 gate valves conforming to the requirements of UL 262. Provide all valves from one manufacturer.

2.1.2.2 Check Valves

Provide a protective interior coating in accordance with AWWA C550. Swing-check type, AWWA C508 or UL 312 and:

- a. AWWA C508: Iron or steel body and cover and flanged ends
- b. UL 312: Cast iron or steel body and cover, flanged ends, and designed for a minimum working pressure of 200 psi.

Materials for UL 312 check valves are to match the reference standards specified in AWWA C508. Provide check valves with a clear port opening. Provide spring-loaded check valves where indicated. Class 125 flanges are to match ASME B16.1. Provide all check valves from one manufacturer.

2.1.2.3 Water Service Valves

2.1.2.3.1 Gate Valves Smaller than 3 Inch in Size

Gate valves smaller than 3 inch size MSS SP-80, Class 150, solid wedge, nonrising stem, with flanged or threaded end connections, a union on one side of the valve, and a handwheel operator.

2.1.2.4 Indicator Posts

Provide for gate valves where indicated. Provide upright gate valve with indicator post in accordance with UL 789 and NFPA 24, where indicated. Top of the post shall be set between 32 and 40 inches above the final grade. Construct indicator post body of cast iron, ductile iron or a combination of both, bronze operating nut, cast iron locking wrench meeting the requirements of ASTM A126 Class B, with open and shut target window. Provide Fusion Bonded Epoxy Coating in accordance with ANSI/ AWWA C550.

2.1.2.5 Valve Boxes

Provide a valve box for each gate valve, except where indicator post is shown. Construct adjustable valve boxes manufactured from cast iron of a size compatible for the valve on which it is used. Provide cast iron valve boxes with a minimum cover and wall thickness of 3/16 inch and conforming to ASTM A48/A48M, Class 35B. Coat the cast-iron box with a heavy coat of bituminous paint. Provide a round head. Cast the word "WATER" on the lid. The minimum diameter of the shaft of the box is 5 1/4 inches.

2.1.3 Fire Hydrants And Hose Houses

2.1.3.1 Fire Hydrants

Provide fire hydrants where indicated. Paint fire hydrants with at least one coat of primer and two coats of enamel paint. Paint barrel and bonnet colors in accordance with UFC 3-600-01. Stencil fire hydrant number and main size on the fire hydrant barrel using black stencil paint.

Provide a protective epoxy interior coating conforming to AWWA C550 on

those portions of the fire hydrant continuously in contact with sea water or salt water.

2.1.3.1.1 Dry-Barrel Type Fire Hydrants

Provide Dry-barrel type fire hydrants, AWWA C502 or UL 246, "Base Valve" with 6 inch inlet, 5 1/4 inch valve opening, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections. Individually valve pumper connection and hose connections with independent nozzle gate valves.

Provide mechanical-joint end only inlet, except where flanged end is indicated; with end matching requirements as specified in AWWA C502 for size and shape of operating nut, cap nuts, and threads on hose and pumper connections. Provide fire hydrants with frangible sections as mentioned in AWWA C502. Provide fire hydrant with special couplings joining upper and lower sections of fire hydrant barrel and upper and lower sections of fire hydrant stem that break from a force imposed by a moving vehicle. Hydrants shall be painted yellow and shall be Waterous type.

2.1.3.1.2 Yard Hydrant

Provide Frost Proof Yard Hydrant with self-draining shut-off valve installed below the frost line or 4 feet minimum below grade.

2.1.4 Meters

Submit certificates certifying all required and recommended tests set forth in the referenced standard and AWWA M6 have been performed and comply with all applicable requirements of the referenced standard and AWWA M6 within the past three years. Include certification that each meter has been tested for accuracy of registration and that each meter complies with the accuracy and capacity requirements of the referenced standard when tested in accordance with AWWA M6.

Include a register with all meters whether they are or are not connected to a remote reading system.

2.1.4.1 Compound Type Meters

Provide AWWA C702 Advanced Metering Infrastructure (AMI) and Direct Digital Communication (DDC) compatible meter with strainers. Main casing constructed of copper alloy containing not less than 75 percent copper with protective coating in accordance with AWWA C213 or AWWA C550. Equip with tapped bosses near the outlet for field testing purposes.

2.1.5 Disinfection

Chlorinating materials are to conform to: Chlorine, Liquid: AWWA B301; Hypochlorite, Calcium and Sodium: AWWA B300.

2.2 ACCESSORIES

2.2.1 Pipe Restraint

Provide pipe anchorage designed for a minimum working pressure of 150 psi and in accordance with AWWA C600. Provide plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, with thrust restraint. Securely anchor valves or provide with thrust restraints to prevent movement. Install thrust restraints made from

either thrust blocks or, for ductile-iron pipes, restrained joints.

2.2.1.1 Thrust Blocks

Use ASTM C94/C94M concrete having a minimum compressive strength of 2,500 psi at 28 days. Provide concrete thrust blocking of a mix not leaner than: 1 cement, 2-1/2 sand, and 5 gravel. Place blocking between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, place the base and thrust bearing sides of thrust blocks directly against undisturbed earth. Place the side of thrust blocks not subject to thrust against forms, if applicable. Provide the area of bearing as shown or as directed. Place blocking so that the fitting joints are accessible for repair. Use steel rods and clamps, protected by galvanizing or by coating with bituminous paint, to anchor vertical down bends into gravity thrust blocks.

2.2.1.2 Joint Restraint

Provide restrained joints in accordance with DIPRA TRD.

Provide mechanical joint restraint or restraint devices with gripper wedges incorporated into a follower gland and specifically designed for the pipe material and meeting the requirements of AWWA C110/A21.10.

2.2.2 Tapping Sleeves

Provide cast gray, ductile, malleable iron or stainless steel, split-sleeve type tapping sleeves of the sizes indicated for connection to existing main with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Utilize similar metals for bolts, nuts, and washers to minimize the possibility of galvanic corrosion. Provide dielectric gaskets where dissimilar metals adjoin. Provide a tapping sleeve assembly with a maximum working pressure of 150 psi. Provide bolts with square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, utilize an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pre-torqued to 50 foot-pound.

2.2.3 Tapping Saddles

Provide ductile iron type with steel straps and rubber sealing gasket. Provide a tapping saddle assembly with a minimum pressure rating of 250 psi.

2.2.4 Backflow Preventor

Provide Reduced Pressure Backflow Preventer meeting the requirements of AWWA C511-97 and NSF/ANSI 61. Device shall be rated to 180°F and 175 psi working pressure, with full port ball valves. Provide Bronze main body for size 3/4". Provide reinforced Nylon housing and silicon (FDA approved) seat disc elastomers. Provide first and second checks accessible for maintenance without removing the device from the line. Service of all internal components shall be through a single access bronze cover secured with stainless steel bolts. The assembly shall also include four resilient seated test cocks and an air gap drain fitting.

2.2.5 Sleeve-Type Mechanical Couplings

Use couplings, AWWA C219 to join plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling consists of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. Provide true circular middle ring and the follower rings sections free from irregularities, flat spots, and surface defects; provide for confinement and compression of the gaskets. For ductile iron pipe, the middle ring is cast-iron. Malleable and ductile iron are to meet the requirements of ASTM A47/A47M and ASTM A536, respectively. Use gaskets for resistance to set after installation and to meet the requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Provide track-head type bolts ASTM A307, Grade A, with nuts, ASTM A563, Grade A; or round-head square-neck type bolts, ASME B18.5.2.1M and ASME B18.5.2.2M with hex nuts, ASME B18.2.2. Provide 5/8 inch diameter bolts; minimum number of bolts for each coupling is 6 for 8 inch pipe. Shape bolt holes in follower rings to hold fast to the necks of the bolts used. Do not use mechanically coupled joints using a sleeve-type mechanical coupling as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint. Provide a tight flexible joint with mechanical couplings under reasonable conditions, such as pipe movements caused by expansion, contraction, slight settling or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Match coupling strength to that of the adjoining pipeline.

2.2.6 Insulating Joints

Provide a rubber-gasketed insulating joint or dielectric coupling between pipe of dissimilar metals which will effectively prevent metal-to-metal contact between adjacent sections of piping.

2.2.7 Dielectric Fittings

Install dielectric fittings between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains to prevent metal-to-metal contact of dissimilar metallic piping elements and compatible with the indicated working pressure.

2.2.8 Tracer Wire for Nonmetallic Piping

Provide a continuous bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length over each separate run of nonmetallic pipe.

2.2.9 Water Service Line Appurtenances

2.2.9.1 Corporation Stops

Ground key type; lead-free bronze, ASTM B61 or ASTM B62; compatible with the working pressure of the system and solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

2.2.9.2 Curb or Service Stops

Ground key, round way, inverted key type; made of lead-free bronze, ASTM B61 or ASTM B62; and compatible with the working pressure of the system. Provide compatible ends for connection to the service piping. Cast an arrow into body of the curb or service stop indicating direction of flow.

2.2.9.3 Curb Boxes

Provide a curb box for each curb or service stop manufactured from cast iron, size capable of containing the stop where it is used. Provide a round head. Cast the word "WATER" on the lid. Factory coat the box with a heavy coat of bituminous paint.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Connections to Existing System

Perform all connections to the existing water system in the presence of the Contracting Officer.

3.1.2 Operation of Existing Valves

Do not operate valves within or directly connected to the existing water system unless expressly directed to do so by the Contracting Officer.

3.1.3 Earthwork

Perform earthwork operations in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

3.2 INSTALLATION

Install all materials in accordance with the applicable reference standard, manufacturers instructions and as indicated herein.

3.2.1 Piping

3.2.1.1 General Requirements

Install pipe, fittings, joints and couplings in accordance with the applicable referenced standard, the manufacturer's instructions and as specified herein.

3.2.1.1.1 Termination of Water Lines

Terminate the work covered by this section at a point approximately 5 feet from the building, unless otherwise indicated.

Do not lay water lines in the same trench with gas lines, fuel lines, electric wiring, or any other utility. Do not install copper tubing in the same trench with ferrous piping materials. Where nonferrous metallic pipe (i.e., copper tubing) crosses any ferrous piping, provide a minimum vertical separation of 12 inches between pipes.

3.2.1.1.2 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Under no circumstances is it permissible to drop or dump pipe, fittings, valves, or other water line material into trenches. Cut pipe cleanly, squarely, and accurately to the length established at the site and work into place without springing or forcing. Replace a pipe or fitting that does not allow sufficient space for installation of jointing material. Blocking or wedging between bells and spigots is not permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at the design elevation and grade. Secure firm, uniform support. Wood support blocking is not permitted. Lay pipe so that the full length of each section of pipe and each fitting rests solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports for fastening work into place. Make provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been assembled. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation.

3.2.1.1.3 Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.2.1.1.4 Connections to Existing Water Lines

Make connections to existing water lines after coordination with the facility and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped and as indicated, except as otherwise specified, tap concrete pipe in accordance with AWWA M9 for tapping concrete pressure pipe.

3.2.1.1.5 Sewer Manholes

No water piping is to pass through or come in contact with any part of a sewer manhole.

3.2.1.1.6 Water Piping Parallel With Sewer Piping

Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer than 10 feet, horizontally, from any sewer line.

- a. Normal Conditions: Lay water piping at least 10 feet horizontally from sewer or sewer manhole whenever possible. Measure the distance from outside edge to outside edge of pipe or outside edge of manhole. When local conditions prevent horizontal separation install water piping in a separate trench with the bottom of the water piping at least 18 inches above the top of the sewer piping.
- b. Unusual Conditions: When local conditions prevent vertical separation, construct sewer piping of AWWA compliant ductile iron water piping and

perform hydrostatic sewer test, without leakage, prior to backfilling. When local conditions prevent vertical separation, test the sewer manhole in place to ensure watertight construction.

3.2.1.1.7 Water Piping Crossing Sewer Piping

Provide at least 18 inches above the top (crown) of the sewer piping and the bottom (invert) of the water piping whenever possible. Measure the distance edge-to-edge. Where water lines cross under gravity sewer lines, construct sewer line of AWWA compliant ductile iron water piping with rubber-gasketed joints and no joint located within 10 feet, horizontally, of the crossing. Lay water lines which cross sewer force mains and inverted siphons at least 2 feet above these sewer lines; when joints in the sewer line are closer than 3 feet horizontally from the water line relay the sewer line to ensure no joint closer than 3 feet.

- a. Normal Conditions: Provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping in cases where water piping crosses above sewer piping.
- b. Unusual Conditions: When local conditions prevent a vertical separation described above, construct sewer piping passing over or under water piping of AWWA compliant ductile iron water piping and perform hydrostatic sewer test, without leakage, prior to backfilling. Construct sewer crossing with a minimum 20 feet length of the AWWA compliant ductile iron water piping, centered at the point of the crossing so that joints are equidistant and as far as possible from the water piping. Protect water piping passing under sewer piping by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on or damage to the water piping.

3.2.1.1.8 Penetrations

Provide ductile-iron or Schedule 40 steel wall sleeves for pipe passing through walls of valve pits and structures. Fill annular space between walls and sleeves with rich cement mortar. Fill annular space between pipe and sleeves with mastic.

3.2.1.1.9 Flanged Pipe

Only install flanged pipe aboveground or with the flanges in valve pits.

3.2.1.2 Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

- a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 and AWWA M41 for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 and AWWA M41 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make

flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fitting has dimensions that do not allow the making of a flanged joint as specified, replace it. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer. Make grooved and shouldered type joints with the couplings previously specified for this type joint connecting pipe with the grooved or shouldered ends specified for this type joint; assemble in accordance with the recommendations of the coupling manufacturer. Make insulating joints with the gaskets, sleeves, washers, bolts, and nuts previously specified for this type joint. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves are to be full size for the bolt holes. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.

- b. Allowable Deflection: Follow AWWA C600 and AWWA M41 for the maximum allowable deflection. If the alignment requires deflection in excess of the above limitations, provide special bends or a sufficient number of shorter lengths of pipe to achieve angular deflections within the limit set forth.

3.2.1.3 Polyethylene (PE) Piping

Install PE pipes in accordance with AWWA M55 and ASTM D2774.

3.2.1.4 Metallic Piping for Service Lines

Install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

3.2.1.4.1 Joints for Copper Tubing

Cut copper tubing with square ends; remove fins and burrs. Replace dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints using ASTM B32, 95-5 tin-antimony or Grade Sn96 solder. Use solder and flux containing less than 0.2 percent lead. Before making joint, clean ends of tubing and inside of fitting or coupling with wire brush or abrasive. Apply a rosin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and flare tubing.

3.2.1.4.2 Flanged Joints

Make flanged joints up tight, avoid undue strain on flanges, valves, fittings, and accessories.

3.2.1.5 Plastic Service Piping

Install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the applicable requirements of ASTM D2774 and

ASTM D2855, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F402.

3.2.1.5.1 Jointing

Make solvent-cemented joints for PVC piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D2855. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.2.1.5.2 Plastic Pipe Connections to Appurtenances

Connect plastic service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.2.1.6 Fire Protection Service Lines for Sprinkler Supplies

Connect water service lines used to supply building sprinkler systems for fire protection to the water main in accordance with NFPA 24.

3.2.1.7 Water Service Piping

3.2.1.7.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at the points indicated; close such water service lines with plugs or caps.

3.2.1.7.2 Water Service Line Connections to Water Mains

Connect water service lines less than 3 inches to the main by a corporation stop and gooseneck and install a service stop below the frostline as indicated. Connect water service lines to ductile-iron water mains in accordance with AWWA C600 for service taps.

3.2.2 Meters

Install meters and meter vaults at the locations shown on the drawings. Center meters in the vaults to allow for reading and ease of removal or maintenance. Set top of box or vault at finished grade.

3.2.3 Disinfection

Prior to disinfection, provide disinfection procedures, proposed neutralization and disposal methods of waste water from disinfection as part of the disinfection submittal. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Disinfect new water piping using the AWWA C651 continuous-feed method of chlorination. Ensure a free chlorine residual of not less than 10 parts per million after 24 hour holding period and prior to performing bacteriological tests.

3.2.4 Flushing

Perform bacteriological tests prior to flushing. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 parts per million, the residual chlorine

content of the distribution system, or acceptable for domestic use. Use AWWA C655 neutralizing chemicals.

3.2.5 Pipe Restraint

3.2.5.1 Concrete Thrust Blocks

Install concrete thrust blocks where indicated.

3.2.5.2 Restrained Joints

Install restrained joints in accordance with the manufacturer's instructions.

3.2.6 Valves

3.2.6.1 Gate Valves

Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509 or AWWA C515, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509 or AWWA C515. Install gate valves on PVC and PVC0 water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.

3.2.6.2 Check Valves

Install check valves in accordance with the applicable requirements of AWWA C600 for valve-and-fitting installation, except as otherwise indicated. Make and assemble joints to check valves as specified for making and assembling the same type joints between pipe and fittings.

3.2.7 Fire Hydrants

Install fire hydrants in accordance with AWWA C600 for fire hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Install fire hydrants with the 4 1/2 inch connections facing the adjacent paved surface. If there are two paved adjacent surfaces, install fire hydrants with the 4 1/2 inch connection facing the paved surface where the connecting main is located.

3.3 FIELD QUALITY CONTROL

3.3.1 Tests

Notify the Contracting Officer a minimum of five days in advance of hydrostatic testing. Coordinate the proposed method for disposal of waste water from hydrostatic testing. Provide documentation that all items of work have been constructed in accordance with the Contract documents.

3.3.1.1 Hydrostatic Test

Test the water system in accordance with the applicable AWWA standard

specified below. Where water mains provide fire service, test in accordance with the special testing requirements given in the paragraph SPECIAL TESTING REQUIREMENTS FOR FIRE SERVICE. Test ductile-iron water mains in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints is not to exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other methods. Test water service lines in accordance with requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at copper pipe joints, copper tubing joints (soldered, compression type, brazed), plastic pipe joints. Do not backfill utility trench or begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 7 days after placing of the concrete.

3.3.1.2 Leakage Test

For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

For PE perform leak testing in accordance with ASTM F2164.

3.3.1.3 Bacteriological Testing

Perform bacteriological tests in accordance with AWWA C651. Analyze samples by a certified laboratory, and submit the results of the bacteriological samples.

3.3.1.4 Backflow Preventer Tests

After installation conduct Backflow Preventer Tests and provide test reports verifying that the installation meets the FCCCHR Manual Standards.

3.3.1.5 Special Testing Requirements for Fire Service

Test water mains and water service lines providing fire service or water and fire service in accordance with NFPA 24. The additional water added to the system must not exceed the limits given in NFPA 24

3.3.1.6 Tracer Wire Continuity Test

Test tracer wire for continuity after service connections have been completed and prior to final pavement or restoration. Verify that tracer wire is locatable with electronic utility locating equipment. Repair breaks or separations and re-test for continuity.

3.4 SYSTEM STARTUP

Water mains and appurtenances must be completely installed, disinfected, flushed, and satisfactory bacteriological sample results received prior to permanent connections being made to the active distribution system. Obtain approval by the Contracting Officer prior to the new water piping being placed into service.

3.5 CLEANUP

Upon completion of the installation of water lines and appurtenances,
remove all debris and surplus materials resulting from the work.

-- End of Section --

SECTION 33 30 00

SANITARY SEWERAGE
05/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C600	(2017) Installation of Ductile-Iron Mains and Their Appurtenances
AWWA C605	(2014) Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVC0) Pressure Pipe and Fittings
AWWA C900	(2016) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
AWWA C909	(2016) Molecularly Oriented Polyvinyl Chloride (PVC0) Pressure Pipe, 4 In. (100 mm) and Larger

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM C94/C94M	(2020) Standard Specification for Ready-Mixed Concrete
ASTM C150/C150M	(2020) Standard Specification for Portland Cement
ASTM C270	(2019) Standard Specification for Mortar for Unit Masonry
ASTM C443	(2020) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C923	(2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals

ASTM C1244	(2011; R 2017) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2412	(2011) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	(2007; R 2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F477	(2014) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1998) Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor's License; G

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Precast Concrete Manholes

Frames, Covers, and Gratings

Gravity Pipe

Pressure Pipe

Gaskets

SD-06 Test Reports

Precast Concrete Sewer Manhole Test; G

Hydrostatic Sewer Test; G

Negative Air Pressure Test; G

Low-Pressure Air Tests; G

Tests For Pressure Lines; G

Deflection Testing

SD-07 Certificates

Portland Cement

Gaskets

Pre-Installation Inspection Request; G

Post-Installation Inspection; G

1.3 QUALITY CONTROL

1.3.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in the state where the work is to be performed. Verify installing Contractor's License is current and state certified or state registered.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.4.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.4.1.2 Cement, Aggregate, and Reinforcement

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

1.4.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench. Store solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe in accordance with the manufacturer's recommendation and discard those materials if the storage period exceeds the recommended shelf life. Discard solvents in use when the recommended pot life is exceeded.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals of polyvinyl chloride (PVC) plastic pipe. Provide building connections of polyvinyl chloride (PVC) plastic pipe. Provide new exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls.

2.1.2 Sanitary Sewer Pressure Lines

Provide pressure lines of polyvinyl chloride (PVC) plastic pressure pipe.

2.2 MATERIALS

Provide materials conforming to the respective specifications and other requirements specified below. Submit manufacturer's product specification, standard drawings or catalog cuts.

2.2.1 Gravity Pipe

2.2.1.1 PVC Gravity Sewer Piping

2.2.1.1.1 PVC Gravity Pipe and Fittings

ASTM D3034, SDR 35, with ends suitable for elastomeric gasket joints.

2.2.1.1.2 PVC Gravity Joints and Jointing Material

Provide joints conforming to ASTM D3212. Gaskets are to conform to ASTM F477.

2.2.2 Pressure Pipe

2.2.2.1 PVC Pressure Pipe and Associated Fittings

Pipe, couplings and fittings are to be manufactured of materials

conforming to AWWA C909, Pressure Class 165 psi. Pipe compound shall conform to ASTM D1784, Class 12454B.

Provide joints conforming to ASTM D3139 and gaskets conforming to ASTM F477.

2.2.3 Cement Mortar

Provide cement mortar conforming to ASTM C270, Type M with Type II cement.

2.2.4 Portland Cement

Submit certificates of compliance stating the type of cement used in manufacture of precast manholes. Provide portland cement conforming to ASTM C150/C150M, Type II for concrete used in manholes and type optional for cement used in concrete cradle, concrete encasement, and thrust blocking.

2.2.5 Portland Cement Concrete

Provide portland cement concrete conforming to ASTM C94/C94M, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement is to have a compressive strength of 2500 psi minimum at 28 days. Protect concrete in place from freezing and moisture loss for 7 days.

2.2.6 Precast Concrete Manholes

Provide precast concrete manholes, risers, base sections, and tops conforming to ASTM C478 and be manufactured in accordance with Section 03 42 13.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION; base and first riser are to be monolithic.

2.2.7 Gaskets and Connectors

Provide gaskets for joints between manholes and sections conforming to ASTM C443. Resilient connectors for making joints between manhole and pipes entering manhole are to conform to ASTM C923.

2.2.8 Frames, Covers, and Gratings for Manholes

Submit certification on the ability of frame and cover to carry the imposed live load. Frame and cover are to be cast gray iron, ASTM A48/A48M, Class 35B. Frames and covers are to be circular without vent holes. Size are to be as indicated on the plans. Stamp or cast the words "SANITARY SEWER" into covers so that it is plainly visible.

2.2.9 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27 As an option, plastic or rubber coating pressure-molded to the steel may be used. Provide plastic coating conforming to ASTM D4101, copolymer polypropylene. Rubber is to conform to ASTM C443, except shore A durometer hardness is to be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

2.2.10 Manhole Ladders

Provide a zinc hot-dip galvanized coated steel ladder where the depth of a manhole exceeds 12 feet. The ladder is not to be less than 16 inches in

width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers are to be a minimum 3/8 inch thick and 2 inches wide. Galvanize ladders and inserts after fabrication in conformance with ASTM A123/A123M.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Installation Drawings

Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.

3.2 INSTALLATION

Backfill after inspection by the Contracting Officer. Before, during, and after installation, protect plastic pipe and fittings from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer.

3.2.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.2.1.1 Location

Terminate the work covered by this section at a point approximately 5 feet from the building, unless otherwise indicated. Install pressure sewer lines beneath water lines only, with the top of the sewer line being at least 2 feet below bottom of water line. When these separation distances can not be met, contact the Contracting Officer for direction.

3.2.1.1.1 Sanitary Piping Installation Parallel with Water Line

3.2.1.1.1.1 Normal Conditions

Install sanitary piping or manholes at least 10 feet horizontally from a water line whenever possible. Measure the distance from edge-to-edge.

3.2.1.1.1.2 Unusual Conditions

When local conditions prevent a horizontal separation of 10 feet, the sanitary piping or manhole may be laid closer to a water line provided that:

- a. The top (crown) of the sanitary piping is to be at least 18 inches below the bottom (invert) of the water main.
- b. Where this vertical separation cannot be obtained, construct the sanitary piping with AWWA-approved ductile iron water pipe pressure and conduct a hydrostatic sewer test without leakage prior to backfilling.
- c. The sewer manhole is to be of watertight construction and tested in place.

3.2.1.1.2 Installation of Sanitary Piping Crossing a Water Line

3.2.1.1.2.1 Normal Conditions

Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 18 inches between the top of the sanitary piping and the bottom of the water line whenever possible.

3.2.1.1.2.2 Unusual Conditions

When local conditions prevent a vertical separation described above, use the following construction:

- a. Construct sanitary piping passing over or under water lines with AWWA-approved ductile iron water pressure piping and conduct a hydrostatic sewer test without leakage prior to backfilling.
- b. Protect sanitary piping passing over water lines by providing:
 - (1) A vertical separation of at least 18 inches between the bottom of the sanitary piping and the top of the water line.
 - (2) Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.
 - (3) That the length, minimum 20 feet, of the sanitary piping be centered at the point of the crossing so that joints are equidistant and as far as possible from the water line.

3.2.1.1.3 Sanitary Sewer Manholes

No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.2.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 11 00 CLEARING AND GRUBBING 31 23 00.00 20 EXCAVATION AND FILL.

3.2.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay non-pressure pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Construct branch connections by use of regular fittings or solvent cemented saddles as approved. Provide saddles for PVC pipe conforming to Table 4 of ASTM D3034.

3.2.2 Special Requirements

3.2.2.1 Installation of PVC Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.2.2.2 Installation of PVC Pressure Pipe

Unless otherwise specified, install pipe and fittings in accordance with AWWA C605. AWWA C605 includes requirements such as excavation, installation, and placement of appurtenances.

3.2.2.2.1 Pipe 4 inch Diameter And Larger

Make push-on joints with AWWA C900 pipe with integral elastomeric gasket. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel. For push-on joint connections to fittings, use cut spigot end of pipe off square, marked to match the manufacturer's insertion line and beveled to match factory supplied bevel. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of AWWA C605. Assemble push-on joints for connection to fittings in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints or flanged joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories or with the applicable requirements of AWWA C600 for ductile iron joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for mechanical-joint or flanged joint connections and do not bevel.

3.2.2.2.2 Pipe Anchorage

Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C94/C94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.2.3 Concrete Work

Cast-in-place concrete is included in Section 03 30 00 CAST-IN-PLACE CONCRETE. Support the pipe on a concrete cradle, or encased in concrete where indicated or directed.

3.2.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside

contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Perform cast-in-place concrete work in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.2.5 Miscellaneous Construction and Installation

3.2.5.1 Connecting to Existing Manholes

Connect pipe to existing manholes such that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. Center the connection on the manhole. Holes for the new pipe are to be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cut the manhole in a manner that will cause the least damage to the walls.

3.2.5.2 Metal Work

3.2.5.2.1 Workmanship and Finish

Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

3.2.5.2.2 Field Painting

After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal, remove mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.3 FIELD QUALITY CONTROL

The Contracting Officer will conduct field inspections and witness field tests specified in this section. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.3.1 Tests

Perform field tests and provide labor, equipment, and incidentals required for testing.

3.3.1.1 Hydrostatic Sewer Test

When unusual conflicts are encountered between sanitary sewer and waterlines a hydrostatic pressure sewer test will be performed in accordance with the applicable AWWA standard for the piping material or AWWA C600.

3.3.1.2 Leakage Tests for Non-pressure Lines

Test lines for leakage by negative air pressure tests. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

3.3.1.2.1 Negative Air Pressure Test

3.3.1.2.1.1 Precast Concrete Manholes

Test precast concrete sewer manhole test in accordance with ASTM C1244. The allowable vacuum drop is located in ASTM C1244 Make calculations in accordance with the Appendix to ASTM C1244.

3.3.1.2.2 Low-Pressure Air Tests

3.3.1.2.2.1 PVC Pipelines

Test PVC pipe in accordance with UBPPA UNI-B-6. The allowable pressure drop is located in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.3.1.3 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standard specified in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 50 psi in excess of the maximum working pressure of the system, but not less than 100 psi, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3.1.3.1 PVC Pressure Pipe

Test PVC pressure pipe in accordance with the requirements of AWWA C605 for hydrostatic and leakage tests. The quantity of water that must be supplied during testing is not to exceed the quantity of water calculated in accordance with AWWA C605 to maintain the specified test pressure within 5 psi.

3.3.1.4 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D2412. Deflection of pipe in the installed pipeline under external loads is not to exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

3.3.1.4.1 Pull-Through Device

This device is to be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Space circular sections on the shaft so that the distance from external faces of front and back sections will equal or exceed the diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections are to conform to the following:

- a. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.
- b. Homogeneous material throughout, is to have a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.
- c. Center bored and through-bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.
- d. Suitably Back each eye or loop with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

3.3.1.4.2 Deflection Measuring Device

Sensitive to 1.0 percent of the diameter of the pipe being tested and be accurate to 1.0 percent of the indicated dimension. Prior approval is required for the deflection measuring device.

3.3.1.4.3 Pull-Through Device Procedure

Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

3.3.1.4.4 Deflection measuring device procedure

Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and

completely retest in same manner and under same conditions.

3.3.1.5 Dye Test

Perform a dye test from the projects sanitary sewer point of connection to the first downstream manhole on the next active sanitary sewer branch main. Use nontoxic non-staining sewer tracing dye. Test results are to be noted in the daily Construction Quality Control (CQC) Report as required in 01 45 00.00 20 Quality Control.

- a. Continue testing until it can be visually confirmed by way of the dye that the sewer connection is appropriate or until deficiencies are discovered.
- b. During the test, monitor the storm drainage system downstream from the project, either manholes or outfalls, for any sign of cross-connection.

3.3.2 Inspection

3.3.2.1 Pre-Installation Inspection

Prior to connecting the new service, perform pre-installation inspection after trenching and layout is complete. Submit pre-installation inspection request for field support at least 14 days in advance. The Installation's Utilities Field Support personnel will perform the pre-installation inspection.

3.3.2.2 Post-Installation Inspection

Perform a post-installation inspection after connection has been made and before the connection is buried. Submit post-installation inspection request for field support at least 14 days in advance. The Installation's Utilities Field Support personnel will perform the post-connection inspection. During the post-installation inspection the Contractor will be responsible for performing a dye test.

-- End of Section --

SECTION 33 31 23.00 10

SANITARY SEWER FORCE MAIN PIPING
08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1 (2020) Gray Iron Pipe Flanges and Flanged
Fittings Classes 25, 125, and 250

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4 (2016) Cement-Mortar Lining for
Ductile-Iron Pipe and Fittings for Water

AWWA C110/A21.10 (2012) Ductile-Iron and Gray-Iron Fittings
for Water

AWWA C111/A21.11 (2017) Rubber-Gasket Joints for
Ductile-Iron Pressure Pipe and Fittings

AWWA C150/A21.50 (2014) Thickness Design of Ductile-Iron
Pipe

AWWA C151/A21.51 (2017) Ductile-Iron Pipe, Centrifugally
Cast

AWWA C600 (2017) Installation of Ductile-Iron Mains
and Their Appurtenances

AWWA C909 (2016) Molecularly Oriented Polyvinyl
Chloride (PVC) Pressure Pipe, 4 In. (100
mm) and Larger

ASTM INTERNATIONAL (ASTM)

ASTM D1248 (2016) Standard Specification for
Polyethylene Plastics Extrusion Materials
for Wire and Cable

ASTM D2564 (2012) Standard Specification for Solvent
Cements for Poly(Vinyl Chloride) (PVC)
Plastic Piping Systems

ASTM D3139 (2019) Joints for Plastic Pressure Pipes
Using Flexible Elastomeric Seals

ASTM D3308 (2012; R 2017) Standard Specification for
PTFE Resin Skived Tape

ASTM F477 (2014) Standard Specification for
Elastomeric Seals (Gaskets) for Joining
Plastic Pipe

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA TRD (2016) Thrust Restraint Design for Ductile
Iron Pipe

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Ductile Iron Piping

PVC Pressure Pipe

Joints

Push-On Joint Fittings

Flanged Joints

SD-06 Test Reports

Disposal of Waste Water

Final Test Report

1.3 DELIVERY, STORAGE, AND HANDLING

Do not damage pipe, fittings and accessories, and pipe coatings during delivery, handling, and storage.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

Provide piping in locations and sizes as specified in the following table. Also conform to the respective specifications and other requirements specified below

Location	Piping Size Range	Piping Material
Force Mains	6 inches in diameter and larger	PVC Plastic
Inside Lift Stations	6 inches in diameter and larger	Ductile Iron Pipe with Bolted Flange Joints

2.1.1 Plastic Pipe

2.1.1.1 PVC Pressure Pipe

- a. PVC Pressure Pipe and Fittings are to be manufactured of materials conforming to AWWA C909, Pressure Class 165 psi with push-on joints.

2.2 Joints

2.2.1 PVC Piping

Provide centering rings or stops to ensure couplings used with plain end pipe are centered on the joint.

2.2.1.1 Push-On Joint Fittings

Provide joints conforming to ASTM D3139 and gaskets conforming to ASTM F477.

2.2.1.2 Solvent Cement

Pipe compound shall conform to ASTM D2564, Class 12454B.

2.2.2 Ductile Iron Piping

- a. Ductile iron Piping shall be Class 52 conforming to AWWA C150/A21.50 and AWWA C151/A21.51 flanged. Flanged pipe shall have factory assembled, long hub screw on flanges and conform to ASME/ANSI B16.1 for 125 pound bolting.
- b. All ductile iron pipe shall be double cement mortar lined conforming to AWWA C104/A21.4 with seal coat inside. Thickness of ductile iron piping shall conform to AWWA C150/A21.50.

2.2.2.1 Flanged Joints

- a. Ductile iron fittings shall be provided with ductile iron piping and shall be flanged, conforming with AWWA C110/A21.10 and double cement mortar lined conforming to AWWA C104/A21.4 with seal coating inside twice. Seal coat shall be bituminous paint, oil cut (emulsion not acceptable), 2 mils dry film thickness, minimum.
- b. Ductile iron fittings shall match Class 52 ductile iron pipe and conform to AWWA C150/A21.50 for pipe wall thickness. Flanged fittings shall be 125 pound conforming to ASME B16.1.

- c. Rubber Gaskets shall conform to AWWA C111/A21.11, full face as appropriate to the connecting fittings. Surface to be gasketed shall be thoroughly cleaned before assembly, removing paint, dirt spatter and similar items.

2.2.2.2 Polyethylene Encasement

- a. Buried ductile iron pipe and fittings shall be encased in low-density polyethylene film tubes in accordance with AWWA Standard C105.
- b. Polyethylene film shall conform to the following requirements of ASTM D1248-89:
 - 1. Raw Material -
 - Type:1
 - Class: A (natural color)
 - Grade: E-1
 - Flow Rate: 0.4g/10 min.(maximum)
 - Dielectric Strength: Volume resistivity, 10 15 ohm-cm, (min.)
 - 2. Physical properties:
 - Tensile Strength: 1200 psi (min.)
 - Elongation: 300%, (min.)
 - Dielectric Strength: 800V/mil thickness, (min.)
- c. Low-density polyethylene film shall have a nominal thickness of 0.008 in. (8 mil.) with a minus tolerance of 10% of the nominal thickness.

2.2.2.3 Coating System

Apply to the exterior surfaces of ductile iron pipes and fittings a Fusion-Bonded Epoxy Coating that is a one-part, heat curable, thermosetting epoxy coating designed for corrosion protection of metal. The epoxy coating shall be a minimum of 15 mils nominal thickness. Coating shall be NSF/ANSI 61 certified.

2.3 MISCELLANEOUS MATERIALS

Provide miscellaneous materials in compliance with the following requirements:

2.3.1 Joint Lubricants

Provide joint lubricants as recommended by the pipe manufacturer.

2.3.2 Bolts, Nuts and Glands

All bolts, nuts, washers and fasteners shall be stainless steel conforming to Type 316L, unless otherwise indicated. Bolts for fastening all flanged or mechanical joint piping, fittings and valves shall be stainless steel, Type 316L. All bolts on valves, fittings, hangers and supports, etc. shall be stainless steel, Type 316L.

2.3.3 Joint Compound

A stiff mixture of graphite and oil or inert filler and oil.

2.3.4 Joint Tape

ASTM D3308.

2.3.5 Bond Wire

Bond wire type RHW or USE, Size 1/0 AWG, neoprene jacketed copper conductor shaped to stand clear of the joint.

2.3.6 Pipe Support

- a. Supports and hangers shall be furnished where shown on the Drawings, where required by the piping manufacturer and where designated by the Engineer.
- b. Pipe Supports: Saddle type, steel, epoxy coated, adjustable.
- c. Provide 1/8-inch thick neoprene material between piping and saddle supports.

PART 3 EXECUTION

3.1 INSTALLATION

Install pipe, pipe fittings, and appurtenances at the locations indicated. Perform excavation, trenching, and backfilling as specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

3.1.1 Cutting

Cut pipe in a neat manner with mechanical cutters. Use wheel cutters where practicable. Grind sharp and rough edges smooth and remove loose material from the pipe before laying.

3.1.2 Laying

Except where otherwise authorized, lay pipe with bells facing the direction of laying. Before lowering and while suspended, inspect the pipe for defects. Reject defective material. Lay pipe in compliance with the following:

Ductile Iron	AWWA C600
Polyvinyl Chloride	Manufacturer's instructions

3.1.3 Jointing

3.1.3.1 Joints for PVC Pipe

- a. Make threaded joints by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. Tighten the joint with strap wrenches taking care not to damage the pipe and fittings. Tighten the joint no more than 2 threads past hand-tight.
- b. Bevel the ends of pipe for push-on joints to facilitate assembly. Mark pipe to indicate when the pipe is fully seated. Lubricate the

gasket to prevent displacement. Ensure the gasket remains in proper position in the bell or coupling while the joint is made.

- c. Ensure solvent-weld joints comply with the manufacturer's instructions.

3.1.3.2 Joints for Ductile Iron Pipe

Install mechanical and push-on type joints in compliance with AWWA C600 and the manufacturer's instructions. Install flanged joints in compliance with manufacturer's instructions.

3.1.4 Installation of Valve Vaults and Flow Meter Vaults

Install valve vaults and flow meter vaults as indicated.

3.1.5 Thrust Restraint

Provide plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, with thrust restraint. Securely anchor valves or provide with thrust restraints to prevent movement. Install thrust restraints made from either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.5.1 Thrust Blocks

Provide concrete thrust blocking of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Place blocking between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, place the base and thrust bearing sides of thrust blocks directly against undisturbed earth. Place the side of thrust blocks not subject to thrust against forms, if applicable. Provide the area of bearing as shown or as directed. Place blocking so that the fitting joints are accessible for repair. Use steel rods and clamps, protected by galvanizing or by coating with bituminous paint, to anchor vertical down bends into gravity thrust blocks.

3.1.5.2 Restrained Joints

For ductile iron pipe, design restrained joints in accordance with DIPRA TRD.

3.1.6 Grout

Provide grout mix for exterior joint protection on concrete pipes of 1 part portland cement, 2 parts sand, and of sufficient liquid consistency to flow into the joint recess beneath the diaper. Provide grout mix for interior joint protection of 1 part portland cement and 1 part sand. Substitute a polyurethane foam loop, impregnated with portland cement, in lieu of grout for exterior joints, if directed.

3.1.7 Bonded Joints

Where indicated, provide a thermally welded metallic bond at each joint, including joints made with flexible couplings or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity.

3.2 FIELD QUALITY CONTROL

Perform both a pressure test and a leakage test on all pipelines. Obtain the Contracting Officer's approval of the method proposed for disposal of waste water from hydrostatic tests. The Contractor is responsible for all testing. Contractor will coordinate all tests to ensure they are witnessed by the Contracting Officer. Notify the Contracting Officer at least 7 days in advance of equipment tests. Submit the final test report to the Contracting Officer within 30 days after the test.

3.2.1 Pressure Test

After installing the pipe, joints, and thrust blocks, wait at least five days before pressure testing. For the pressure test, partially backfill the trench but leave the joints exposed for examination, then fill the pipe with water to expel all air. Subject the pipeline to a test pressure of 100 psi or 150 percent of the working pressure, whichever is greater, for a period of at least one hour. Open and close each valve several times during the test. Examine the exposed pipe, joints, fitting, and valves for leaks. Stop visible leaks or replace defective pipe, fittings, joints, or valves.

3.2.2 Leakage Test

Conduct the leakage test subsequent to or concurrently with the pressure test. Place the amount of water permitted as leakage for the line in a sealed container attached to the supply side of the test pump. Apply no other source of supply to the pump or line under test. Pump the water into the line by the test pump as required to maintain the specified test pressure as described for a 2 hour period. The test will be considered a failure upon exhaustion of the supply or the inability to maintain the required pressure. PE pipe experiences diametric expansion and pressure elongation during initial testing. Consult the manufacturer prior to testing for special testing considerations. Determine allowable leakage by the following I-P formula:

$L = NDP/K$ Where:

L = Allowable leakage in gallons per hour.

N = Number of joints in length of pipeline tested.

D = Nominal diameter of the pipe in inches.

P = Square root of the test pressure in psig.

K = 7400 for pipe materials.

At the conclusion of the test, measure the amount of water remaining in the container and record the results in the test report.

Test ductile iron pressure lines in accordance with the requirements of AWWA C600.

Test plastic pressure lines in accordance with the recommendations of AWWA C605.

3.2.3 Retesting

If any deficiencies are revealed during any test, correct such deficiencies and repeat the tests until the results of the tests are within specified allowances, without additional cost to the Government.

-- End of Section --

SECTION 33 32 16

PACKAGED UTILITY WASTEWATER PUMPING STATIONS
11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3 (2016) Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.11 (2016) Forged Fittings, Socket-Welding and Threaded

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110/A21.10 (2012) Ductile-Iron and Gray-Iron Fittings for Water

AWWA C115/A21.15 (2020) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges

AWWA C517 (2009) Resilient-Seated Cast-Iron Eccentric Plug Valves

AWWA C600 (2017) Installation of Ductile-Iron Mains and Their Appurtenances

AWWA C605 (2014) Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M (2003; R 2012) Standard Specification for Gray Iron Castings

ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A108 (2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

ASTM A126 (2004; R 2019) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A536 (1984; R 2014) Standard Specification for Ductile Iron Castings

ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C443	(2020) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1	(2003; R 2008) Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 3	(2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC
NEMA ICS 4	(2015) Application Guideline for Terminal Blocks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 67	(2018; Reprint Jul 2020) UL Standard for Safety Panelboards
UL 489	(2016) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

UL 508 (2018) UL Standard for Safety Industrial
Control Equipment

UL 1059 (2001; Reprint Dec 2017) UL Standard for
Safety Terminal Blocks

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.90.1 (2013) Standard for Surge Withstand
Capability (SWC) Tests for Relays and
Relay Systems Associated with Electric
Power Apparatus

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

Erection/Installation Drawings

SD-03 Product Data

Submersible Sewage Pumps; G

Pump Performance Curve; G

Pump Motor; G

Pump Control System; G

Submit in booklet form, indexed to the unique identifiers, consisting of data sheets that document compliance with the specification. Where multiple components are shown on a catalog cut, mark the application specific component.

Control Panel; G

Pressure Indicating Gauge; G

Flow Meter Vault, Wet Well and Valve Vault; G

Valves; G

Spare Parts Data; G

Access Hatch Covers; G

Tipping Float Switch; G

Submersible Transducer/Transmitter; G

Magnetic Flow Measuring Systems; G

SD-05 Design Data

Buoyancy Calculations; G

SD-06 Test Reports

Pump Test; G

Pressure Sensor Test; G

Float Test; G

Performance Verification Test (PVT); G

SD-07 Certificates

Submersible Sewage Pumps; G

Recycled Material Content; G

Manhole Chamber; G

Access Hatch Covers

Plug Valves; G

Check Valves; G

Pump Motor; G

SD-08 Manufacturer's Instructions

Manhole Chamber; G

Access Hatch Covers

Pump Control System; G

Check Valves; G

Pump Motor; G

Special Tools; G

Posted Instructions; G

SD-10 Operation and Maintenance Data

Operation And Maintenance Manuals

Training Manual; G

SD-11 Closeout Submittals

Warranty; G

1.3 QUALITY CONTROL

1.3.1 Installer Qualifications

Provide manufacturer's authorized pump representative who is trained and approved for installation of pumps and packaged pump station required for this project.

1.3.2 Quality Assurance

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section. The control system PLC programming shall be open source and available to be accessed/read and reprogrammed with a widely available software package.

1.3.2.1 Factory Pump Tests

Factory tests shall be performed for all pump units.

The Standards of the Hydraulic Institute, latest edition, shall govern all factory testing.

Each pump shall deliver the rate of flow at the head conditions specified and shall have characteristics as indicated by the pump characteristic curves previously submitted in the shop drawings. Tests shall provide readings to determine flow, differential pressure, rpm, horsepower, and efficiency.

Each pump shall be operated for not less than one hour and readings shall be taken to determine that the pump will operate without cavitation at the minimum head condition specified with not more than the specified NPSH available.

Motor testing including:

- Winding resistance

- Motor speed at 100%, 75% and 50% load

- Motor efficiency at 100%, 75% and 50% load

- Motor power factor at 100%, 75% and 50% load

- Input current at 100%, 75% and 50% load

- Power input at 100%, 75% and 50% load

Contractor shall submit certified factory pump test results to the Engineer for review prior to shipment. Test results shall indicate the serial numbers of each unit tested.

No pump shall be shipped until the Certified Test Statements have been reviewed and accepted by the Engineer.

1.3.2.2 Factory Acceptance Panel Tests

Prior to shipment, the pump station control system including the panel, PLC, peripherals, communications equipment, etc. provided by this work shall be assembled, connected, and all software loaded for a full functional factory acceptance test (FAT) of the integrated system.

In preparation for the FAT, the Contractor shall check, troubleshoot, debug and test the control system prior to arrival of the Engineer in order for the system to be ready for the FAT, minimize testing time, and minimize re-testing during the visit. Similar testing shall be performed even if the Engineer chooses not to witness the FAT.

The Contractor shall allow the Engineer and Owner to inspect the control system and witness the functional testing of the system at the site of assembly and integration of the system.

A minimum of 21 Days notification shall be given to the Engineer prior to testing. No shipments shall be made without the Engineer's approval. A successful completion of the test is a prerequisite to the shipment of the system.

The factory test will be witnessed by the Engineer (2 persons) and the Owner (2 persons). The Contractor shall pay and provide for travel, food, and lodging for all the test witnesses.

The factory acceptance test shall be conducted at the place where the system was engineered, fabricated, assembled, and programmed.

It is considered reasonable that once scheduled, the system will be ready for the test and the test will be successfully completed in one session. If during the test, at the opinion of the Engineer and in accordance with the test procedure, the system is not ready for the test or has failed, and the Engineer and the Owner must extend their stay or leave and arrive at another date, the Owner reserves the right to withhold monies due to the Contractor to cover additional costs of the Engineer's time, travel, food, and lodging and associated project cost.

During the factory acceptance test, the Contractor's Project Manager and software engineers (OIT application software and PLC programming) who worked on the PCIS shall be available on the premises where the test is being conducted for explanation, demonstration or corrections.

After the successful completion of the test, the Engineer will generate a punch list. The list may include items that must be corrected or addressed prior to the shipment of the system, and/or items that must be corrected later in the field during installation and startup.

The PLC, OIT and dialer shall be included in the factory test as representatives of the system.

1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials in enclosures or under protective covering. Rubber gaskets which are not to be installed immediately must be stored under cover, out of direct sunlight. Do not store materials

directly on the ground. Keep interior of pipes, valves and fittings free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, and other accessories in such manner as to ensure delivery to the trench in sound, undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Carry pipe to the trench; do not drag it. Do not use any device or fitting inserted into (such as loader forks) or attached to (such as chain hooks) the bell or spigot ends of the pipe to transport pipe. Handle ductile iron pipe, fittings, and accessories in accordance with AWWA C600. Handle PVC pipe, fittings, and accessories in accordance with AWWA C605.

1.5 WARRANTY

Provide manufacturer's standard warranty for a minimum of one year for package pump station including pumps, valves, controls, wet well basin and accessories.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a complete packaged sewage pump station with Submersible Sewage Pumps including equipment and materials, installed and ready for operation. The pump supplier furnishes the controls, pumps and rail system to ensure unit integrity.

Submit fabrication drawings before installation. Submit drawings covering necessary or recommended changes to accommodate the equipment offered. Show on the drawings the design of the chamber, with dimensions, types, and thicknesses of materials, and elevation levels with reference to those elevations indicated.

Submit erection/installation drawings for the manhole chamber with the required equipment and accessories. Provide precast reinforced concrete manhole sections conforming to ASTM C478. Show the design of the chamber, with dimensions, types, and thicknesses of materials, and elevation levels with reference to those elevations indicated.

2.2 SUBMERSIBLE SEWAGE PUMPS

Provide submersible close-coupled sewage pumps as indicated. Provide UL listed pumps for explosion proof Class 1, Division 1, Groups C and D hazardous locations. The hydraulic of the pump shall be capable of handling domestic wastewater with fibrous materials like wet wipes. Provide pump capacity, number of pumps and motor characteristics as indicated on the drawings. Select pumps to continuously operate in a submerged or partially submerged condition.

2.2.1 Pump Construction

2.2.1.1 Casing

Provide hard, close-grained cast iron casing is free from blow holes, porosity, hard spots, shrinkage defects, cracks, and other injurious defects. Provide casings permitting replacement of wearing parts. Ensure

all joints are gasketed to prevent leakage. Ensure passageways permit smooth flow of sewage and are free of sharp turns and projections.

2.2.1.2 Impeller

Provide a semi open multi vane type alloy 2205 duplex stainless steel impeller for each submersible sewage pump. Ensure the impeller has a smooth surface and allows free flowing with the clearance to permit objects in the sewage to pass. Fit and key, spline, or thread impeller on shaft, and lock in such manner that lateral movement is prevented and reverse rotation will not cause loosening.

2.2.1.3 Bearings

Provide heavy duty ball thrust bearing or roller type bearing sized to withstand imposed loads. Oil lubricate bearings.

2.2.1.4 Lubrication

Motor bearings shall be permanently grease lubricated and have a nominal L10 lifetime of 50,000 hours.

2.2.1.5 Balance

Balance rotating parts of the equipment mechanically and hydraulically to operate throughout the required range without excessive end thrust, vibration, and noise. Conform allowable vibration limits with ISO 1940-1, Table 1. Existence of defects that cannot be eliminated by adjustment will be sufficient cause for rejection of the equipment.

2.2.1.6 Pump Guide Rail and Discharge Connection

For each pump the contractor shall supply and install a discharge connection made of cast iron ASTM A-48, Class 35B.

The outlet flange of the discharge connection shall be 6" drilled according to ANSI B16.1-89; tab.5.

The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. The material of the guide bars shall 316L stainless steel.

The length of the guide bars shall be coordinated by the Contractor, and they shall fasten at the top of the station with a guide bar holder made of 316L stainless steel.

For each pump the Contractor shall supply and install a cable holder made with 4 hooks of 316L stainless steel.

The sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be accepted. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.

2.3 PUMP MOTOR

The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an oil filled, watertight chamber. It shall be permanently submersible according to standard IEC 60034 and protection class IP 68.

The motor shall be provided with an integral motor cooling system. A 316 stainless steel cooling jacket shall encircle the stator housing. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow. The cooling system shall have one fill port and one drain port integral to the cooling jacket.

The pump shall be capable of operating in a continuous condition in a liquid with a temperature up to 104°F even when the motor is not submerged.

The stator windings shall be insulated with moisture resistant Class H insulation rated for 356°F.

Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable.

It shall be possible to lift and lower the pumps on parallel guide bars and connect them to wet well mounted discharge connection.

Provide hermetically sealed electric motors with moisture and temperature-sensing probes in the wet well NEMA MG 1, 460 volt, 3 phase, and 60 Hz cycle for submersible pumps. Motor horsepower must not be less than pump horsepower at any point on the pump performance curve. Fit motors with lifting "eyes" capable of supporting entire weight of pump and motor. Seal the power cable inside the motor end bell. Provide a waterproof power cable for its full length. Motors shall be UL listed for explosion proof Class 1, Division 1, Groups C and D. Air filled motors are not acceptable. Oil used must be able to be disposed as non-hazardous waste.

Parameter	Lift Station 1	Lift Station 2
Quantity	2	2
Type	Submersible Sewage Pump	Submersible Sewage Pump
Horse Power/Speed	2.4HP/1665 RPM	5HP/1760 RPM
Design Point #1 (duty point) Flow/Total Dynamic Head	360 gpm/12.2 feet	560 gpm/18.77 feet

2.4 PUMP CONTROL SYSTEM

2.4.1 General

Provide an automatic type pump operating control including all necessary components to function reliably. Mount controls in a NEMA rated Type 416 stainless steel control panel. Ensure equipment subject to contact with sewage or sewage gases is corrosion-resistant metal. Provide a programmable logic controller that automatically activates and alternates the pump operation. If the liquid level continues to rise to the plans-specified level, the controller engages both pumps to operate simultaneously until both shut off at the specified low level. Provide hand-off-auto switches to choose the mode of operation for each pump.

Protect pumping stations from lightning and transient voltage surges and equip with phase protection.

Design the control system to operate pumps at the power characteristics as shown on the plans. Ensure all controls and wiring meet or exceed the requirements of NFPA 70.

For pumps specified as explosion proof, have pump power and control installation meets NEC requirements for Class 1, Division 1, Group D Hazardous Location, including intrinsically safe controls. Provide components that are UL listed or FM approved.

Require the control function to provide for the operation of the pumps under normal conditions and alternates the pumps on each pump down cycle.

In the event the incoming flow exceeds the pumping capacity of the lead pump, the offline pumps automatically start to handle the increased flow. As the flow decreases, the pumps cut off at the elevations set on the controller.

2.4.2 Enclosure

Provide a NEMA 4X rated enclosure manufactured from 316 stainless steel. The enclosure is a wall mount type suitable for mounting on strut or channel with a minimum depth sized to adequately house all the components. Provide a rubber composition door gasket and assures a positive weatherproof seal. Provide a door that opens a minimum of 180 degrees and is equipped with a 3-point latch and padlockable handle.

Provide a dead front mounted in the panel to provide protection of personnel from live internal wiring. Install cutouts for breaker handles to allow operation of breakers without entering the compartment.

Mount all control switches, indicator pilot lights, elapsed time meters, duplex receptacle and other operational devices on the external surface of the dead front.

Ensure the dead front opens a minimum of 150 degrees to allow access to equipment for maintenance.

Manufacture the back plate from 12-gauge (minimum) steel and finished with a primer coat and two (2) coats of baked on white enamel. Mount all hardware to the subpanel with machine thread tapped holes. Sheet metal screws are not acceptable. Permanently identify all devices to match the schematic diagram.

In enclosures where excessive internal heat or internal moisture is a problem, the enclosure shall be equipped with louvers with filters and a cooling fan. The perimeters of the louver plate shall be sealed with a gasket. Louver shall be of the same material and finish as the enclosure. The louver shall be sized for effective heat rejection.

Heating and cooling calculations shall be provided for the enclosure along with the required heating and cooling devices.

2.4.3 Tipping Float Switch

Provide a sealed, mercury-free float switch control system to sense variations of sewage level in the wet well.

Use a direct acting float switch consisting of a normally-open switch enclosed in a float. Use float molded of rigid high-density polyurethane foam, color-coded and coated with a durable, water and corrosion-resistant jacket of clear urethane.

Provide stainless steel float brackets in accordance with manufacturer's recommendations.

Mount floats at fixed elevations as shown on the drawings.

Use floats designed to tilt and operate their switches causing sequential turn-on turn-off of the pump, when the liquid level being sensed rises or falls past the float.

Float switch wiring must use intrinsically safe relays. Provide an intrinsically safe barrier relay between the wet well and the control panel, relays shall be separated within the control panel by metallic barrier or shall be placed in a separate NEMA4 box external to the control panel.

2.4.4 Submersible Transducer Type Level Measurement

2.4.4.1 Description

The submersible level measurement system shall be designed for level and depth measurements in sewage environments. The level measurement system shall consist of a submersible transducer, electronic transmitter, support cable, and interconnecting cable with cable shield, termination enclosure, and vent tube for atmospheric reference. The installation shall allow easy removal of the transducer and cable assembly for maintenance purposes.

2.4.4.2 Performance / Design Criteria:

The transducer shall be the strain gauge type suitable for sensing pressure equivalent to the measured liquid level range. Various pressure ranges shall be available from 1 to 900 psig.

The transducer shall be integral to and suspended by a corrosion resistant cable, as recommended by the manufacture.

The transmitter shall produce a 24 VDC, 4 - 20 mA DC signal linearly proportional to the required level range. The measurement system shall operate over a temperature range of 0 to 140 degrees F with an accuracy of

plus or minus 0.25 percent of full scale.

2.4.4.3 Materials / Components:

2.4.4.3.1 Submersible Transducer/Transmitter:

- a. The wetted parts of the transducer/transmitter's body assembly shall be as recommended by the manufacturer. It shall be rated IP68/Type 6.
- b. Vent Tube: The vent tube shall be used for atmospheric reference and terminated in a sensor termination enclosure. Vent tube shall be able to support a load of up to 115 lb. and its material shall be compatible with the measured liquid level as recommended by the manufacturer for the intended service.
- c. Termination Enclosure: The vent tube shall be terminated in an enclosure rated for the installation location. The enclosure shall contain a replaceable desiccant module with an integral moisture status indicator, and a replaceable micro filter assembly against ingress of dust. A DIN standard terminal block shall also be included. Mounting hardware shall be included for the required installation requirements.

2.4.5 Pressure Indicating Gauge

Pressure gauges shall be 4-1/2 inches, with white laminated dials and black graduations, and have either a shatterproof glass or acrylic window. The gauges' bottom connection size shall be 1/4 inch. Sensing element shall be bourdon tube with welded, stress-relieved joints. Sensing element material shall be as recommended by the manufacturer and as indicated in the data sheet. Gauges shall have an accuracy of plus and minus 1/2-percent of full scale. Body material shall be as recommended by the manufacturer. Gauge shall be liquid-filled. Gauges shall be provided with a 316 stainless steel pulsation dampener (snubber), unless otherwise noted in the data sheet. The pulsating dampener shall absorb system pressure pulses. Pressure Gauges shall be supplied with diaphragm seals.

2.4.6 Magnetic Flow Measuring Systems

2.4.6.1 Description

Magnetic flowmeter systems shall be the low frequency electromagnetic induction type that produces a DC pulsed signal directly proportional to and linear with the liquid flow rate.

2.4.6.2 Performance / Design Criteria

Magnetic flowmeter system shall be suitable for the intended service and shall be based on the conductivity properties and solid content of the process fluid, in accordance with the manufacturer's recommendations.

- a. Magnetic flowmeter system shall be capable of measuring fluid velocities in the range of 0.04 and 39 ft. /sec. in both forward and reverse flow in all sensor sizes.
- b. Accuracy: The flow metering system shall be installed in accordance with the manufacturer's recommendations to provide at least 0.5 percent of flow rate from 10 to 100 percent full scale

for velocities over 3 feet per second.

- c. Repeatability: 0.1 percent of reading.
- d. Power input requirements shall be 120VAC sourced from the LCP.

2.4.6.3 Materials / Components

The magnetic flow metering system shall include a metering tube, transmitter, and signal cable and flowmeter grounding rings.

a. Metering Sensor/Tube:

(1) The metering sensor shall employ a pulsed DC technique to drive flux-producing coils. Sensors using high pulsed DC signals shall be used in accordance with the manufacturer's recommendations for the required service application.

(2) The metering tube sizes shall be available from at least 1/2-inch to 48-inch line size. It shall be sized in accordance with the installation application and the intended service and as recommended by the manufacturer. If fractional size or larger size meters are required, the manufacturer shall be consulted for availability. A wafer type magnetic flow meter shall be provided for applications and installations as recommended by the manufacturer. Metering tube size availability shall be 0.15-inch to 8-inches.

(3) Flanged Connections: The flanges' size, style, type and construction material shall be in accordance with the required installation and the intended service application and as recommended by the manufacturer and as recommended by the manufacturer for the intended service. The metering tube body for the wafer (flangeless) type meter shall be constructed of stainless steel wafer type painted with epoxy paint.

(4) A minimum of two (2) electrodes shall be provided. The electrodes' material shall be suitable for the required service as recommended by the manufacturer. A reference electrode shall be provided as recommended by the manufacturer for the required installation application.

(5) Lining material shall be in accordance with the manufacturer's recommendation for the intended service.

(6) Meter housing shall be rated for NEMA 6P (IP68) (limited depth) and shall be offered with certified ratings for different hazardous locations as specified in the data sheet. It shall be able to operate between -20 to 140 Degrees F (-29 to 60 degrees C).

(7) Meter tube shall have epoxy protective coating.

(8) Grounding rings shall be provided and designed to protect and shield the liner's edge interface from abrasion at the meter end. Grounding rings shall conform to the manufacturer's bore and material recommendation for the intended service. Grounding shall conform to the manufacturer's recommendations. The wafer flow meter system shall utilize two (2) grounding rings for a system ground. Grounding ring material and installation shall conform to

the manufacturer's requirements

b. Transmitter/Converter

(1) The transmitter/converter shall be capable of being mounted integral to the metering tube or remotely as indicated on the drawings. Mounting hardware shall be provided.

(2) The transmitter/converter shall be rated for NEMA 4X (IP67). It shall be able to operate in ambient temperatures of -20 to 140 degrees F (-29 to 60 degrees C).

(3) The transmitter shall convert the DC pulse signal from the metering tube to a linear 4 to 20 mA DC signal into a minimum of 700 ohms. The 4-20 mADC signal shall comply with HART protocol. Output signal shall be continuously adjustable over the full scale. Other digital outputs options shall be available.

(4) The transmitter shall have an LCD displays for flow rate, percent of span, totalization, operator configuration interface, and diagnostic information.

(5) The transmitter shall have an adjustable integral low flow cutoff and zero return.

(6) The transmitter shall perform self-diagnostics and automatic data checking and activate a switch closure output when a transmitter fault is detected.

c. Cables

(1) Remote transmitter configuration shall be provided with the required lengths and types of electrodes and coil drive cables as recommended by the manufacturer for the required installation application. Maximum distance of transmitter from the metering tube shall be as recommended by the manufacturer.

d. Calibration

(1) Each flow metering system shall be hydraulically calibrated at a facility that is traceable to the National Institute of Standards and Technologies. The calibration procedure shall conform to the requirements of ANSI/NCSL Z 540-1 Calibration. A real-time computer generated printout of the actual calibration data shall be submitted to the ENGINEER at least 30 Days prior to shipment to the site.

2.4.7 Pump Control System

2.4.7.1 Programmable Logic Controller (PLC)

2.4.7.1.1 PLC General Requirements

PLCs must be micro-processor based, capable of receiving binary and analog inputs and, through programming, must be able to control relay and analog output functions, perform data handling operations and communicate with external devices. PLCs must meet the requirements of Class A computing devices, and must be labeled as set forth in 47 CFR 15 and must be able to withstand conducted susceptibility test as outlined in

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3, and IEEE C37.90.1. PLCs must function properly at temperatures between 0 and 50 degrees C 32 and 122 degrees F at 5 to 95 percent relative humidity non-condensing and must tolerate storage temperatures between minus 40 and plus 60 degrees C 40 and plus 140 degrees F at 5 to 95 percent relative humidity non-condensing. PLC should be Allen Bradley Micro 1400 or CompactLogix range.

2.4.7.1.2 Modular PLC

PLCs must be based on a modular, field expandable design allowing the system to be tailored to the process control application. The system must be expandable through the use of additional hardware and/or user software. As a minimum, the PLC must include a mounting backplane, power supply module, central processing unit (CPU) module, communications module, and input/output (I/O) module. The modules must be grouped together in a mounting rack or cabinet. The mounting rack backplane must provide the communications mechanism to fully integrate the individual modules located within the rack. Modules other than I/O modules must plug directly into the backplane. The use of wire connectors between modules will not be allowed except for expansion of the system to include multiple backplanes. The rack size must be as needed to hold the equipment necessary while performing the required control functions.

2.4.7.1.3 Central Processing Unit (CPU) Module

The CPU module must be a self contained, microprocessor based unit that provides time of day, scanning, application program execution, storage of application programs, storage of numerical values related to the application process and logic, I/O bus traffic control, peripheral and external device communications and self diagnostics. The scan time must be 250 milliseconds or better including spare I/O channels.

2.4.7.1.4 Communications Module

The communications module must allow peer-to-peer communication with other PLCs and must allow the PLC to communicate with the central station, or workstation. The communication module must utilize the manufacturer's standard communication architecture and protocol, ethernet architecture and protocol or a combination of these. The communication module must allow programming of the PLC to be done locally through the use of a laptop computer.

2.4.7.1.5 Power Supply Module

One or more power supply modules must be provided as necessary to power other modules installed in the same cabinet. Auxiliary power supplies may be used to supply power to remote cabinets or modules.

Power supply modules must use AC power with a nominal voltage of 120 vAc plus or minus 5 percent. The power supply module must monitor the incoming line voltage level and must provide over current and over voltage protection. If the voltage level is detected as being out of range the power supply module must continue to provide power for an adequate amount of time to allow for a safe and orderly shutdown. Power supply modules must be capable of withstanding a power loss for a minimum of 20 milliseconds while still remaining in operation and providing adequate power to all connected modules.

Each power supply module must be provided with an on-off switch integral to the module. If the manufacturer's standard power supply module is not provided with an on-off switch, a miniature toggle type switch must be installed near the PLC and must be clearly labeled as to its function.

Provide power supply modules with an indicating light which must be lit when the module is operating properly.

2.4.7.1.6 Input/Output (I/O) Modules

Modules must be self contained, microprocessor based units that provide an interface to field devices. The modules must be located in the same cabinet as the other PLC components. Each module must contain visual indication to display the on-off status of individual inputs or outputs. Each I/O must be protected against reversal of polarity of the signal. Analog inputs and analog outputs must have 'open, short and out of range circuit' detection. It must be configurable per channel.

2.4.7.1.7 Program Storage/Memory Requirements

The CPU must utilize the manufacturer's standard non-volatile memory for the operating system. The controller must have electronically readable and writeable non volatile memory (EPROM, EEPROM, or Flash PROM) battery backup volatile memory. Must be possible to change battery with power on for storage of user programs. The user programs must be loaded through the through the use of a laptop computer. The CPU memory capacity must be based on the system's control requirements. The memory capacity must be sized such that, when the system is completely programmed and functional, no more than 50 percent of the memory allocated for these purposes is used.

2.4.7.1.8 Input/Output Characteristics

Each controller must allow for analog input, analog output, binary input and binary output. The number and type of inputs and outputs for the system must be as shown on the drawings and must comply with the sequence of control. The system capacity must include a minimum of 20 percent spare input and output points (no less than two points) for each point type provided. During normal operation, a malfunction in any input/output channel must affect the operation of that channel only and must not affect the operation of the CPU or any other channel. All input circuits must have a minimum optical isolation of 1500 VRMS and must be filtered to guard against high voltage transients from the externally connected devices. All output circuits must have a minimum optical isolation of 1500 VRMS and must be filtered to guard against high voltage transients from the externally connected devices.

2.4.7.1.9 Analog Inputs

Analog input circuits must be available in 4-20 mA.

2.4.7.1.10 Digital Inputs

Binary input circuits must be available in 10-30 vDc.

2.4.7.1.11 Analog Outputs

Analog output circuits must be available in 4-20 mA.

2.4.7.1.12 Relay Outputs

Binary output circuits must be available in 10-30 vDc.

2.4.7.1.13 Pulse Inputs

Pulse inputs must be able to detect a pulse of 1 milliseconds or less.

2.4.7.1.14 Wiring Connections

Wiring connections must be heavy duty, self lifting, pressure type screw terminals to provide easy wire insertion and secure connections. The terminals must accept two #14 AWG wires. A hinged protective cover must be provided over the wiring connections. The cover must have write-on areas for identification of the external circuits.

2.4.7.1.15 On-Off Switch

Each controller must be provided with an integral on-off power switch. If the controller is not provided with a manufacturer's standard on-off switch, a miniature toggle type switch must be installed in the control panel near the controller and must be clearly labeled as to its function.

2.4.7.1.16 Diagnostics

Each PLC must have diagnostic routines implemented in firmware. The CPU must continuously perform self-diagnostic routines that will provide information on the configuration and status of the CPU, memory, communications and input/output. The diagnostic routines must be regularly performed during normal system operation. A portion of the scan time of the controller must be dedicated to performing these housekeeping functions. In addition, a more extensive diagnostic routine must be performed at power up and during normal system shutdown. The CPU must log input/output and system faults in fault tables which must be accessible for display. When a fault affects input/output or communications modules the CPU must shut down only the hardware affected and continue operation by utilizing the healthy system components. All faults must be annunciated at the PLC and the OIT. Diagnostic software must be useable in conjunction with the portable tester. The following diagnostics must be performed:

- a. Analog Inputs: Sensor out of range, open or shorted loop, analog-to-digital converter check
- b. Analog Outputs: Open or shorted loop
- c. Configuration: Check compatibility and availability of selected I/O hardware and software
- d. Memory: Checksum, parity check End-to End CPU memory

2.4.7.1.17 Accuracy

Controllers shall have an accuracy of plus or minus 0.25 percent of input span.

2.4.7.2 PLC Software and OIT

All PLC and OIT software described in this specification shall be

furnished as part of the complete control system.

2.4.7.2.1 Operating System

Each PLC must be provided with the manufacturer's standard operating system software package. The PLC must maintain a point database in its memory that includes all parameters, constraints and the latest value or status of all points connected to the PLC. Execution of the PLC application programs must use the data in memory resident files. The operating system must support a full compliment of process control functions. It must be possible to define these functions using a mix of ladder logic diagrams, function blocks, sequential function charts and text programming. Programming methods and interactions must be based on IEC 61131-3. A combination of the programming methods must be possible within a single controller. The operating system must allow loading of control logic locally. It must also support data entry and diagnostics using an operator interface panel attached directly to the PLC. Each PLC must be capable of operating in standalone mode.

2.4.7.2.2 Startup

The PLC must have startup software that causes automatic commencement of operation without human intervention, including startup of all connected I/O functions. A PLC restart program based on detection of power failure at the PLC must be included in the PLC software. The restart program must include start time delays between successive commands to prevent demand surges or overload trips.

2.4.7.2.3 Failure Mode

Upon failure for any reason, each PLC must perform an orderly shutdown. Systems which are not Primary/Secondary must force all PLC outputs to a predetermined (failure mode) state, consistent with the failure modes shown and the associated control device. Primary/Secondary systems must transfer I/O scan and control to the PLC not currently failed.

2.4.7.2.4 Functions

The controller operating system must be able to scan inputs, control outputs, and read and write to its internal memory in order to perform the required control as indicated in the sequence of control on the drawings. The controller must periodically perform self diagnostics to verify that it is functioning properly.

2.4.7.2.5 Analog Monitoring

The system shall measure and transmit all analog values including calculated analog points.

2.4.7.2.6 State Variables

If an analog point represents more than two (up to 8) specific states, each state must be nameable. For example, a level sensor must be displayed at its measured engineering units plus a state variable with named states usable in programs or for display such as low alarm/low/normal/high/high alarm.

2.4.7.2.7 Binary Alarms

Binary alarms are those abnormal conditions indicated by BIs as specified and shown. The system must automatically suppress analog alarm reporting associated with a binary point when that point is turned off.

2.4.7.2.8 Analog Alarms

Analog alarms are those conditions higher or lower than a defined value, as measured by an AI. Analog readings must be compared to predefined high and low limits, and alarmed each time a value enters or returns from a limit condition. Unique high and low limits must be assigned to each analog point in the system. In control point adjustment (CPA) applications, key the limit to a finite deviation traveling with the setpoint. The system must automatically suppress analog alarm reporting associated with an analog point when that analog point is turned off.

2.4.7.2.9 Pulse Accumulator (PA) Alarms

Pulse accumulator alarms are those conditions calculated from totalized values of accumulator inputs or PA input rates that are outside defined limits as specified and shown. PA totalized values must be compared to predefined limits and alarmed each time a value enters a limit condition. Unique limits must be assigned to each PA point in the system.

2.4.7.2.10 Constraints

a. Equipment Constraints Definitions

Each control point in the database must have PLC resident constraints defined and entered by the Contractor, including as applicable: maximum starts (cycles) per hour; minimum off time; minimum on time; high limit (value in engineering units); and low limit (value in engineering units).

b. Constraints Checks

All control devices connected to the system must have the PLC constraints checked and passed before each command is issued. Each command point must have unique constraints assigned. High and low "reasonableness" values or one differential "rate-of-change" value must be assigned to each AI. Each individual point must be capable of being selectively disabled by the operator from the central station.

c. Control Sequences and Control Loops

Specific functions to be implemented are defined in individual system control sequences and database tables shown on the drawings, and must include, as applicable, the following functions: PI control must provide proportional control and proportional plus integral control; two position control must provide control for a two state device by comparing a set point against a process variable and an established dead band; floating point control must exercise control when an error signal exceeds a selected dead band, and must maintain control until the error is within the dead band limits; signal selection must allow the selection of the highest or lowest analog value from a group of analog values as the basis of control and must include the ability to cascade analog values so that large numbers of inputs can be reduced to one or two outputs; signal averaging must allow the mathematical

calculation of the average analog value from a group of analog values as the basis of control and must include the ability to "weight" the individual analog values so that the function output can be biased as necessary to achieve proper control; reset function must develop an AO based on up to two AIs and one operator specified reset schedule.

d. Command Priorities

A scheme of priority levels must be provided to prevent interaction of a command of low priority with a command of higher priority. Override commands entered by the operator must have higher priority than those emanating from applications programs.

e. Resident Application Software

Provide resident applications programs developed in accordance with paragraph Graphical Object Oriented Programming to achieve the sequences of operation, parameters, constraints, and interlocks necessary to provide control of the process systems connected to the process control system.

All application programs must be resident in the PLC and must execute in the PLC, and must coordinate with each other, to insure that no conflicts or contentions remain unresolved.

f. Program Inputs and Outputs

Use program inputs listed for each application program to calculate the required program outputs. Where specific program inputs are not available, a "default" value or virtual point appropriate for the equipment being controlled and the proposed sequence of operation must be provided to replace the missing input, thus allowing the application program to operate.

g. Failure Mode

In the event of a PLC failure, the controlled equipment must continue to function in the failure mode shown on the drawings. Systems that are Primary/Secondary must transfer control to the non-failed system.

2.4.7.3 Touchscreen OIT

Operator Interface Terminal (OIT) display screens must be supplied to provide an interface to the PLC. The touch screens must be compatible with the specific PLC being furnished. The touch screens shall be located in the control panels as shown in the Contract Drawings. The touch screens shall provide maintenance information and indication of the systems. The touch screens must be 9"panel mount with a minimum resolution of 900x480. The operator interface shall be Allen Bradley PanelView Plus 7 series or Approved Equal.

Contractor shall develop OIT control and supervision display layouts complying with the minimum requirements of the Control Narrative in the Contract Drawings. Submit for approval prior to implementation.

As a minimum, screens included shall be:

Station Overview

Pump Station inc. pump control popups

Flow Trend 7. Day trend screen of flows. (Applicable to only Lift

Station 1)
Flow Totalizer screen (daily, weekly and monthly), flows split by
each flow meter

Setpoints Screen
Alarm Summary/History Screen

2.4.7.4 Functional Description - Lift Stations 1 and 2

2.4.7.4.1 Description:

Flow enters the Lift Station 1 Wet-well by gravity from ships moored at the pier and from a drain located in the ship washdown area.

Flow enters the Lift Station 2 wetwell by forcemain from the Lift Station 1 and by gravity from the NOAA Facility building.

The Pumps are submersible type mixed flow pump suspended on a rail system. The Pumps are located in a wet well and are equipped with starters that start and stop the pumps based on the water level in the wet well.

Flow entering the Lift Station 1 wet well from ship discharge enters via two (2) pipes. Flow monitoring is provided on each pipe and shall be trended for 7 days on the OIT. Daily, weekly, and monthly flow totals shall also be logged on the panel.

2.4.7.4.2 Pump Station Control:

The Local Control Panel (LCP) shall be located near the Pumps and includes the following operator devices for Pump operation:

- a. Pump Hand-Off-Auto 3-position maintained selector switch.
- b. Pump Start momentary pushbutton.
- c. Pump Stop momentary pushbutton.
- d. Pump Reset momentary pushbutton.
- e. Pump Running indicator light.
- f. Pump Off indicator light.
- g. Pump Fail alarm indicator light.
- h. Pump Leak and Motor High Temperature alarm indicator lights via pump protection relay.
- i. E-Stop Push Switch
- j. Pump Elapsed Time Meter
- k. Digital Panel Meter(s)

2.4.7.4.3 Local Manual Control:

Note: The Local Manual Control Mode shall be used for maintenance and troubleshooting purposes only. The Pumps are designed to operate normally

in the Local Automatic Control Mode.

- a. The Pump LCP Hand-Off-Auto selector switch Local Mode enables the pushbuttons located on the LCS and disables control from the PLC.
- b. Place the Hand-Off-Auto selector switch to the Local position.
- c. Depress the Start pushbutton and the Pump will start and run until the operator depresses the Stop pushbutton, the Hand-Off-Auto selector switch is placed in the Auto Mode, or a Pump fault/shutdown condition occurs.
- d. Depress the Stop pushbutton and the Pump will stop.

2.4.7.4.4 Local Automatic Control:

Note: The local Automatic Control Mode shall be used for normal operating conditions.

- a. The Pump LCP Hand-Off-Auto selector switch Auto Mode disables the pushbuttons located on the LCS and enables control from the PLC.
- b. Place the Pump LCP Hand-Off-Auto selector switch to the Auto position.
- c. At the OIT place the Auto-Manual Control Mode poke point to the Auto Mode.

Note: Unless a Pump is out of service, all Pumps shall be placed in the Remote Mode via the Hand-Off-Auto selector switch at each LCP and in the Auto Mode from the poke point at the OIT for proper control in the Remote Automatic Control Mode.

- d. At the OIT select either Pump No. 1, or Pump No. 2 as the Lead and Standby pumps. The duty changeover of pumps shall be selectable as automatic based upon a time basis, automatic based upon start/stop cycle or manual by the operator. If the Lead pump fails, the standby pump shall assume the Lead position.
- e. A submersible level transmitter shall be installed in the wet well. It provides level feedback for Pump control in the Local Automatic Control Mode. In the event that the level transmitter fails, level switches are installed in the wet well and the control system shall revert to float control.

Programmed level setpoints will start and stop the Pumps in the Local Automatic Control Mode, as described below:

Note: All setpoint actions are on an adjustable time delay (1 - 60 seconds, initially set to 15 seconds) to allow for temporary fluctuations in the wet well. If a level setpoint is reached, but not maintained for the duration of the time delay, the time delay is reset and the action will not occur.

Note: All control setpoints are adjustable through the OIT by an operator, with the exception of the alarmed setpoints as described below under the Note column. Once the station is in operation the control setpoints can be adjusted to allow for smoother Pump operation based on typical plant flow conditions.

2.4.7.4.5 Level Setpoint Table:

<u>Setpoint 1</u> Lift Station 1 (ft)	<u>Setpoint 1</u> Lift Station 2 (ft)	<u>Rising Level</u>	<u>Falling Level</u>	<u>Alarm</u>
1.5	1.5			Low Level Alarm (Float - Pump Control)
2.0	2.0		All Pumps Off	
4.5	4.25	Duty pump on		
5.0	5.0			High Level Alarm (Float - Pump Control)
5.5	5.5	Standby Pump On		High-High Level Alarm

Note: 1 - Setpoints are based on height from lift station bottom slab.

Each rising level action and falling level action will have an order of operation, as described below:

a. Rising Level Actions

- (1) Lead Pump to start, no pumps running
- (2) Standby Pump to start, lead pump running

b. Falling Level Actions

- (1) All Pumps to stop - no pumps running

2.4.7.4.6 Pump Alarms

The following Pump alarms will shut down its associated Pump, send an alarm signal to the alarm dialer via hardwired connection from the PLC, and require a reset at the LCP after the fault is cleared.

- a. Pump High Motor Temperature
- b. Pump Leak
- c. Pump Overload
- d. Wet Well Low Level (will shut down the Pumps, but will not require a reset)

The following alarms will send an alarm signal to alarm dialer via the PLC, but will not shut down the Pumps (outside of the normal control method) or require a reset:

a. Wet Well High-High Level

2.4.8 Control Panel

2.4.8.1 Alarms and Alarm Dialer

Provide a test function ability for the alarm system. Provide alarms to activate as per the control descriptions. Alarms Shall be transmitted to the alarm dialer.

2.4.8.1.1 Alarm Dialer

a. Type

- (1) Hardwired Telephone communication circuit.

b. Operator

- (1) To accept a N.O./N.C. contact input and 4-20mA input and transmit the data.
- (2) Alarm data: real-time
- (3) Pump information: pump run times and starts summarized hourly
- (4) Analog reporting: current value reported hourly
- (5) Device health: built-in inputs reported hourly

c. Functional

- (1) Digital inputs: 8 onboard digital inputs (dry) with selectable wire fault supervision, or direct attach current sensing switch (for easiest pump run indication)
- (2) Analog inputs: 2 onboard, 4-20 mA isolated or 0-5 VDC; 4 alarm set points each; expandable to 6 with expansion module
- (3) Power - 120 VAC, 60 Hz, 15 watts
- (4) Battery back-up - 20 hours
- (5) The dialer is to use a standard "dial-up" telephone line (direct leased line is not required), and is to be F.C.C. approved. Connection to the telephone is through a 4-pin modular jack (RJ 11).
- (6) The unit shall be capable of dialing any phone number on command and functioning as a speakerphone.

d. Physical

- (1) Case size - 1.0-in W x 12-in H x 5-in D (approx.)
- (2) Case Material - NEMA 4X enclosure
- (3) Mounting - wall mounted

e. Monitoring points for Lift Station 1 AND 2

- (1) DI - Pump 1 Common Fault
- (2) DI - Pump 2 Common Fault
- (3) DI - High-High Level Alarm
- (4) DI - Utility Power Failure
- (5) DI - 24DC Power Supply Fault
- (6) DI - UPS Fault
- (7) DI - PLC Fault
- (8) DI - Intrusion
- (9) AI - FLOW 1 (Lift Station 1 only)
- (10) AI - FLOW 2 (Lift Station 1 only)

2.4.8.2 Circuit Breakers

- a. Provide an individual circuit breaker for each pump.
- b. Include a control circuit breaker and an alarm circuit breaker in the control panel.
- c. Allow for two additional spare 115V single phase 20A circuit breakers for local pole lighting and future spare.
- d. Provide circuit breakers in accordance with UL 489
- e. Conform to UL 67 for circuit breaker mounting.

2.4.8.3 Reduced voltage Solid State Starters

Provide motor starters in accordance with the following.

The SCR-based power section shall consist of 6 back-to-back SCRs, 2 SCRs per phase, and shall be rated for a minimum peak inverse voltage rating of 2.5 times line voltage, 1200 PIV for 480 volts. Units using triacs or SCR/diode combinations shall not be acceptable. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dv/dt characteristics of the electrical system.

Starters shall include the following logic and control functions:

- Adjustable maximum starting current from 200 percent to 500 percent
- Ramp time adjustment from 1 to 40 seconds
- Adjustable linear voltage deceleration
- Kick start
- Phase loss protection
- Undervoltage protection
- Current unbalance protection
- Phase rotation protection (prevents starting)
- Class 20 electronic overload protection. Heat sink overtemperature protection shall be provided.
- Dry contacts for remote indication of RUN and TRIP status

2.4.8.4 Power Lugs

- a. Size the incoming power lugs for the proper voltage, amperage, and horsepower for each pump station.
- b. Include grounding lugs for the incoming power. Provide a dedicated grounding lug in the control panel for each pump.
- c. Size ground lug and rod according to local and base electrical codes and install by a licensed electrician.
- d. Use UL listed power lugs.
- e. Conform to UL 67 for required power lug mounting.

2.4.8.5 Anti-Condensation Heater

- a. Provide an anti-condensation heater in the control panel that is sized based upon the size of the particular pump station's control panel size.
- b. Power the heater from the control voltage transformer for three phase pump motor units and from the incoming power for single phase pump motor units.
- c. Control the heater by a thermostat, coming on at 50 degree F and going off at 65 degree F.
- d. Clearly label panel directory for breakers.

2.4.8.6 Trouble Light

Provide a LED trouble shooting light in the panel that is hard-wired into an appropriately sized circuit breaker.

2.4.8.7 Convenience Outlets

- a. Place two duplex convenience outlets in the control panel; utilize one for the battery charger. The battery receives power from the control voltage transformer via the alarm fuse.
- b. Upsize the alarm fuse to 1 to 1.5 amps for the battery charger.
- c. Provide each outlet with its own 20 amp 115/1/60 circuit breaker.

2.4.8.8 Control Panel Horn and Beacon

The control panel shall be fitted with a flashing red beacon that is visible from 50 feet away, with long life bulb in guarded enclosure and 6 inch diameter horn. Use horns capable of emitting 120 DB at 10 feet. A push to test button for horn and light and push to silence button for horn and light with automatic reset for next alarm shall be provided

2.4.8.9 Standard Indicator Light

Indicator lights showing on, off, stand-by, automatic, manual depending on the application must comply with NEMA ICS 1, NEMA ICS 2 and UL 508. Lights must be heavy duty, round and must mount in a 22.5 mm 0.875 inch mounting

hole. Indicator lights must be LED type and must operate at 120 vAc or 24 vDc. Long life bulbs must be used. Indicator light must be provided with a legend plate labeled as shown on the drawings. Lens color must be as indicated on the drawings. Lights must be push to test (lamp) type.

2.4.8.10 Selector Switches

Selector switches must comply with NEMA ICS 1, NEMA ICS 2 and UL 508. Selector switches must be heavy duty, round and must mount in a 22.5 mm 0.875-inch mounting hole. The number of positions must be as indicated on the drawings. Switches must be non-illuminated. Switches must be rated for 600 volts, 10 amperes continuous. Selector switches must be provided with a legend plate labeled as shown on the drawings. Where indicated or required, dual auxiliary contacts must be provided for the automatic position to provide position sensing at the PLC/OIT. Auxiliary contacts must be rated for 120 vAc, 1A as a minimum. Where indicated on the drawings, switches must be key operated. All keys must be identical.

2.4.8.11 Push Buttons

Push buttons must comply with NEMA ICS 1, NEMA ICS 2 and UL 508. Push buttons must be heavy duty, round and must mount in a 22.5 mm 0.875 inch mounting hole. The number and type of contacts must be as indicated on the drawings or required by the Sequence of Control. Push buttons must be rated for 600 volts, 10 amperes continuous. Push buttons must be provided with a legend plate labeled as shown on the drawings.

2.4.8.12 Relays

Relays must comply with NEMA ICS 5 and derated for altitude above 1,500 m. Relays at minimum must be double-pole, double-throw (DPDT) accept where used as an interposing relay then as a minimum they shall be single-pole, single-throw (SPST). Relay coil must be 120 vAc or 24 vDc and must be provided with matching mounting socket. Power consumption must not be greater than 3 watts. Contacts must have a minimum current rating of 10 amps and minimum voltage rating of 120 vAc or 24 vDc volts.

2.4.8.13 Terminal Blocks

Terminal blocks must comply with NEMA ICS 4 and UL 1059. Terminal blocks for conductors exiting control panels must be two-way type with double terminals, one for internal wiring connections and the other for external wiring connections. Terminal blocks must be made of bakelite or other suitable insulating material with full deep barriers between each pair of terminals. A terminal identification strip must form part of the terminal block and each terminal must be identified by a number in accordance with the numbering scheme on the approved wiring diagrams.

2.4.8.14 Uninterruptible Power Supply

Provide an uninterruptible AC power supply (UPS) system for each control panel to back up the power for the panel in case utility power fails. The UPS shall be a "smart" type, use on-line, high frequency, double-conversion technology.

The continuous output capacity of the UPS shall be at least 1-hour backup time at 150% load. It shall be sufficient to supply the control panel and peripheral equipment with regulated AC power for a minimum of one (1) hour

from batteries only. Additional batteries or larger UPS size shall be provided to meet the specified backup time.

Provide load and runtime calculations and size each UPS to justify the selection of present and future load requirements, as well as overload and inrush capacity requirements.

Under normal conditions the AC power line shall feed the UPS to power the protected load. The UPS shall also maintain the batteries in fully charged "float" condition. Whenever the normal AC power fails or dips below the normal range, the critical load shall be continuously supplied from the batteries and the double conversion system. The transfer from normal to AC line to backup power shall be bumpless and without a break in the output of the UPS (0 transfer time).

Provide a make-before-break maintenance bypass switch to transfer load to line power. The status of the switch ("In Bypass") shall be reported to the PLC.

Features and Options

Input Power Range: 100 to 132 volts, 60 Hertz +/- 5 Hertz, auto-sensing.

Output Power Range: 110/120 (selectable), +/- 3 percent of nominal, 60 Hertz +/- 0.5 percent.

Output Receptacles: Minimum of six (6) built-in outlets.

Overload Capacity: The UPS shall have the ability to supply 110 percent of system requirements for 10 seconds, without degradation of the service life.

Protection: The UPS output shall be protected (IEEE standards) from lightning, surges overload, and short circuit. The input shall be protected by a circuit breaker, sized in accordance with manufacturer's recommendations.

Battery: Lead acid type, maintenance free, sealed suspended electrolyte, and leak-proof. Recharge Time (with half load): three (3) hours.

Alarms and Status: The UPS shall be provided with a relay output card to provide a common dry contact output that represents the health/status of the UPS and battery functions (i.e. low battery, UPS on batteries, UPS fault, batteries failed on battery self-test).

2.4.8.15 Additional Requirements

- a. Provide elapsed time meter for each pump that measures run time in hours to 9999.9.
- b. Do not place junction boxes between pumps, control systems and control panels; provide conduit seals at all wet well penetrations. If this is unavoidable, use NEMA 7 construction.

2.4.9 Electrical Requirements

Install labels to identify switches and controls. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field installed equipment.

2.5 Flow Meter Vault, Wet Well and Valve Vault

2.5.1 Flow Meter Vault

Provide a precast concrete flow meter vault with inside dimensions as indicated and to the depths indicated on the drawings.

2.5.2 Wet Well and Valve Vault

Provide a precast concrete wet well; include a separate precast concrete valve vault. Provide a wet well and valve vault with inside dimensions as indicated and to the depths indicated on the drawings. Provide drawings and calculations stamped by a licensed professional structural engineer.

2.5.2.1 Precast Concrete Structures

Submit manufacturer's data indicating percentage of recycled material content in packaged sewage lift stations to verify affirmative procurement compliance.

Fly ash is required as an admixture and is to conform to ASTM C618, Class F except that the maximum allowable loss on ignition must not exceed 3 percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 8 percent and a total equivalent alkali content less than 1.5 percent. Fly ash replacement of cement is not to exceed 20 percent (maximum one part fly ash to four parts cement) by weight.

Ground granulated blast furnace slag is used as an admixture and is to conform to ASTM C989/C989M, Grade 120 with between 25 to 50 percent maximum cement replacement by weight. Submit certificate to verify EPA-CPG compliance.

- a. Buoyancy Calculations: Submit buoyancy calculations sealed by a licensed professional structural engineer assuming seasonal high groundwater elevation at proposed finished grade.
- b. Construct precast concrete structures in accordance with ASTM C478, except as specified herein. Provide precast concrete structures with a compressive strength of 4000 psi at 28 days and an air entrainment of 6 percent, plus or minus 2 percent, and a minimum wall thickness of 5 inches. ASTM A615/A615M reinforcing bars. ASTM C443, Type B gaskets for joint connections. Use monolithic base and first riser.

2.5.3 Access Hatch Covers

Provide steel, H20 loading rated access hatch covers with 316 stainless steel hardware, flush with precast cover as indicated. Include lifting mechanism, automatic hold open arm, slam lock with handle, and flush lift handle with vinyl grip. Use automatic hold open arm that locks in the 90 degree position. Use cover that is 1/4 inch diamond plate with 1/4 inch channel frame and continuous anchor flange. Provide 316 stainless steel cylinder lock with two keys per lock. Key all the locks the same. 316

stainless steel hatch frames to include 316 stainless steel drain gutters.

Pump access hatch to be supplied with integral safety grating system. The safety grate shall be made of 6061-T6 aluminum and designed per the "Specifications for Aluminum Structures". The grating shall be designed to withstand 300 psf loading. Each grate shall be supplied with a heavy duty, 316 stainless steel pneumatic-spring for ease of operation when opening. Each grate shall be provided with a permanent hinging system; which will lock the grate in the 90-degree position once opened. Grate shall be coated with an OSHA type safety orange color, base coat is a thermosetting epoxy powder coat finish with a minimum thickness of 2-4 mils.

2.5.4 Wet Well Base Material

Provide crushed stone as indicated and specified in DIVISION 31 EARTHWORK and 31 23 00.00 20 EXCAVATION AND FILL.

2.5.5 Flow Meter and Valve Vault Ladder

The flow meter and valve vaults shall be supplied with an aluminum (6061-T6) wall-mount access ladder. The ladder shall be fastened to the concrete with 316 stainless expansion bolts and shall meet OSHA standard 1910, Subpart D and related standards requirements.

The ladder rails & supports shall be all welded aluminum construction. Rails and wall supports shall be solid 3/8" x 2 1/2" flat stock, and rungs shall have a 1-1/4" diameter with serrated surface extruded into the rung for slip resistance. The minimum design live load shall be a single concentrated load of 200 lbs.

Rung spacing shall be uniform and not exceed 12", the minimum clear length of rungs shall be 15-1/4", and the distance from the center line of the rung to the nearest permanent object shall not be less than 7".

2.5.5.1 Flow Meter and Valve Vault Ladder Extension

The ladder extension assembly shall be constructed of aluminum and stainless steel. The aluminum housing shall mount to the ladder by means of grade 316 stainless steel channel clamps secured to the ladder rungs with grade 316 stainless steel "U" bolts. The aluminum telescoping post shall extend 42" above the top of the housing and lock into position with a grade 316 stainless steel pin.

2.6 VALVES AND OTHER PIPING ACCESSORIES

2.6.1 Plug Valves in Valve Vault

Provide non-Lubricated, eccentric plug valves with 100 percent port as indicated and specified. Provide plug valve conforming to AWWA C517 with flanged ends, flanged conforming to ANSI B16.1, 125 lb or ANSI 150. Provide V-type packing, of the material specified, held in place with a packing gland. Provide permanently lubricated bearings. Provide manufacturers nameplates affixed to each valve.

Provide cast iron, ASTM A126, Class B valve body, bonnet, journal covers and packing gland. Provide ductile iron, ASTM A536, grade 65-45-12 plug with NBR Encapsulation. Provide type 316L stainless steel lower (body) bearing, upper (bonnet), and fasteners and hardware. Provide NBR o-rings

(with non-asbestos based filler) and packing. Provide PTFE grit excluder.

2.6.1.1 Plug Valves Operators

Provide manual handwheel operators with totally enclosed and sealed gearing. Operators shall be grease lubricated and suitable for both above and below ground service. Provide operators with external position indication.

Provide cast iron, ASTM A126, Class B housing and cover, mounting adapter and handwheel. Provide ductile iron, ASTM A536, grade 65-45-12 work gear and ASTM A108, Grade 1045 worm. Provide bronze, permanently lubricated bearings. Provide steel thrust bearings, spring pins, shaft and shaft key. Provide type 316 stainless steel stop adjustment screws, jamb nut, fasteners and hardware. Provide compressed fiber (non-asbestos) gaskets and elastomers. Provide steel and rubber oil seal.

2.6.2 Check Valves

Provide non-clogging swing check valve rated for not less than 175 psig working pressure capable of passing 3-inch diameter solids. Match cast iron to ASTM A126 and flanged ends to AWWA C110/A21.10 Buna-N disc and integral seat.

Provide a positive horizontal, swing check type check valves. Provide valves that permit a free flow of sewage forward and a positive check against backflow. Provide iron body valves with a removable cover for inspection and removal of the gate assembly.

2.6.3 Epoxy Coating

All interior and exterior metal surfaces of valves, except stainless steel, aluminum bronze and/or bronze, shall be protected by a factory applied 2-part self-priming epoxy coating. The epoxy coating shall be a two-part polyamide adduct coating designed to provide maximum corrosion protection on metal surfaces. The exterior coating shall be applied to a minimum thickness of 20 mils (DMT), holiday free, in strict accordance with the coating manufacturer's application procedures. The interior coating shall be applied to a thickness of 6 to 8 mils (DMT), holiday free, in strict accordance with the coating manufacturer's application procedures. The coating shall be inspected visually and electrically for flaws after the coating has cooled to a temperature recommended by the manufacturer. All metal surfaces to which the coating is applied shall be inspected and all defects shall be repaired. A certificate of compliance shall be submitted by the pump and valve manufacturers certifying that the epoxy coating (identified by product name and manufacturer) has been applied to all interior and exterior/interior metal surfaces of valves to a minimum thicknesses specified, visually and electrically inspected, and cured, all in accordance with the coating manufacturer's published literature. The color of the epoxy coating shall be the manufacturer's standard. A sufficient quantity of coating shall be provided to permit field touchup of shipping, handling and installation damages.

2.6.4 Identification Tags and Plates

Provide the manufacturer's name or trademark on a corrosion-resistant identification plate or cast integrally, stamped, or otherwise permanently marked in a conspicuous place on each item of equipment. Include on the pump identification plate the pump capacity in gpm, pump head in feet and

speed of rotation. Cast on the body of the pump the direction of rotation.

2.6.5 Pipe Support

Use pipe support schedule 40 galvanized steel piping matching ASTM A53/A53M. Provide either ASME B16.3 or ASME B16.11 galvanized threaded fittings.

2.6.6 Miscellaneous Metals

Use 316L stainless steel bolts, nuts, washers, anchors, and supports for installation of equipment.

2.6.7 Quick Disconnect System with Hydraulic Sealing Flange and Rail System

Use quick disconnect system consisting of a steel base plate for supporting the pumps, a hydraulic sealing flange, pump guide rails and the discharge pipe supports. Provide stainless steel guide rails, brackets and lifting chain for raising and lowering the pump in the basin. Build guides onto pump housing to fit the guide post to assure perfect alignment between pump and guide rails.

2.6.8 Wet Well Vent

Provide a flanged ductile iron pipe and bend, conforming to AWWA C115/A21.15. Provide vent with galvanized steel bird screen and 1/8" thick EPDM rubber gasket.

2.7 EXCAVATION, TRENCHING, AND BACKFILLING

Provide in accordance with DIVISION 31 EARTHWORK 31 23 00.00 20 EXCAVATION AND FILL, except as specified herein.

PART 3 EXECUTION

3.1 INSTALLATION

Provide pump station in accordance with drawings and requirements of the respective equipment manufacturers. Dampen and isolate equipment vibration.

3.1.1 Equipment Installation

Install equipment in accordance with these specifications and the manufacturer's installation instructions. Grout equipment mounted on concrete foundations before installing piping. Install piping to avoid imposing stress on equipment. Match flanges before securing bolts.

3.1.2 Installation of Ductile-Iron Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS FOR INSTALLATION OF PIPELINES of Section 33 30 00 SANITARY SEWERAGE and 33 31 23.00 10 SANITARY SEWER FORCE MAIN PIPING, and with the requirements of AWWA C600 for pipe installation, joint assembly, and valve-and-fitting installation.

Make flanged joint with gaskets, bolts, and nuts specified for this type joint. Make flanged joints tight, avoid strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use bolts sized for the bolt holes; use of undersized bolts is not permitted. Do

not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange.

3.1.3 Pumps

- a. For each pump the contractor shall supply and install a discharge connection made of cast iron ASTM A48/A48M, Class 35B.
- b. The outlet flange of the discharge connection shall be 6" drilled according ANSI B16.1-89; tab.5.
- c. The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. The material of the guide bars shall Stainless steel AISI 316.
- d. The length of the guide bars shall be coordinated by the contractor and they shall be fasten at the top of the station with a guide bar holder made of Stainless steel AISI 316.
- e. For each pump the contractor shall supply and install a cable holder made with 4 hooks of Stainless steel AISI 316.

3.1.4 Valves

Make and assemble joints to plug valves and check valves as specified for making and assembling the same type joints between pipe and fittings.

Install valves in accordance with manufacturer's installation instructions. Install plug valves as described in AWWA C517, and with AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Plug Valves") to AWWA C517.

3.1.5 Miscellaneous

Attach a plastic laminated final as-built controls drawing to the inside of the front door. Include a list of all legends. Identify the pump nameplate data on the drawing and on the as-built plans.

Permanently mark all component parts in the control panel and identified as they are indicated on the drawing. Mark on the back plate adjacent to the component. Identify all control conductors with wire markers at each end as close as practical to the end of conductor.

3.2 FIELD QUALITY CONTROL

Provide appliances, materials, water, and equipment for testing. Conduct testing after equipment, electrical services, and piping are installed, and the pump station is ready for operation. Correct defects discovered to the satisfaction of the Contracting Officer, and tests repeated, at no expense to the Government, until the equipment functions as intended and designed.

3.2.1 Testing Procedure

Perform a pump test, pressure sensor test, and float test. Submit the

test results to the Contracting Officer.

Perform a Performance Verification Test (PVT) on the completed pump station test. Test all panels to the power requirements as shown on the plans to assure proper component operation. Activate each control function to check for proper operation and indication. The PVT shall be required to be witnessed by the contracting officer or their delegated representative.

3.2.2 Field Representative

A representative of the pump manufacturer is to direct the startup of the station and instruct representatives of the Government in startup and operation procedures.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Operation and Maintenance

Submit operation and maintenance manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA for package lift stations, including Equipment Description, Assembly and Installation Procedures, Adjustment and Alignment, Checkout Procedures, Procedures of Operation and Troubleshooting and a Training Manual. Include preventative maintenance and inspection procedures for package lift stations. Include in procedures the frequency of preventative maintenance, inspection, adjustment, lubrication, and cleaning necessary to minimize corrective maintenance and repair.

Supply special tools that are required for maintenance and testing of the package lift stations.

Submit spare parts data, including a complete list of parts and supplies with current unit prices and source of supply. List parts and supplies that are either normally furnished at no extra cost with the purchase of equipment, or specified to be furnished as a part of the contract, and list additional items recommended by the manufacturer to ensure an efficient operation for a period of one year.

Install on or near the package lift stations, a complete package of posted instructions, consisting of labels, signs, and templates of operating instructions.

Provide a list or reference all specific operation and maintenance procedures that are required to keep the warranty valid.

-- End of Section --

SECTION 33 40 00

STORM DRAINAGE UTILITIES
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 294 (2017) Standard Specification for
Corrugated Polyethylene Pipe, 300- to
1500-mm (12- to 60-in.) Diameter

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M (2003; R 2016) Standard Specification for
Gray Iron Castings

ASTM A123/A123M (2017) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products

ASTM A536 (1984; R 2019; E 2019) Standard
Specification for Ductile Iron Castings

ASTM A929/A929M (2018) Standard Specification for Steel
Sheet, Metallic-Coated by the Hot-Dip
Process for Corrugated Steel Pipe

ASTM B26/B26M (2014; E 2015) Standard Specification for
Aluminum-Alloy Sand Castings

ASTM C32 (2013; R 2017) Standard Specification for
Sewer and Manhole Brick (Made from Clay or
Shale)

ASTM C55 (2017) Standard Specification for Concrete
Building Brick

ASTM C62 (2017) Standard Specification for Building
Brick (Solid Masonry Units Made from Clay
or Shale)

ASTM C76 (2020) Standard Specification for
Reinforced Concrete Culvert, Storm Drain,
and Sewer Pipe

ASTM C139 (2017) Standard Specification for Concrete
Masonry Units for Construction of Catch
Basins and Manholes

ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C425	(2004; R 2013) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C443	(2020) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C506	(2020) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C507	(2020) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C828	(2011) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C923	(2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C969	(2019) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C990	(2009; R 2014) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1103	(2019) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C1433	(2016b) Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1171	(2016; E 2016) Standard Test Method for

Rubber Deterioration - Surface Ozone
Cracking Outdoors (Triangular Specimens)

ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2729	(2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	(2007; R 2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3350	(2012) Polyethylene Plastics Pipe and Fittings Materials
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM F477	(2014) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	(2016) Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

ASTM F714	(2013; R 2019) Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
ASTM F794	(2003; R 2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F894	(2019) Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F1417	(2011a; E 2020) Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
ASTM F2736	(2013; E 2014) Standard Specification for 6 to 30 in. (152 To 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe And Double Wall Pipe
ASTM F2764/F2764M	(2018a) Standard Specification for 6 to 60 in. (150 to 1500 mm) Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
ASTM F2881	(2011) Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Pipe for Culverts and Storm Drains

SD-07 Certificates

Resin Certification

Oil Resistant Gasket

Leakage Test

Hydrostatic Test on Watertight Joints

Determination of Density

Frame and Cover for Gratings

Post-Installation Inspection Report

SD-08 Manufacturer's Instructions

Placing Pipe

SD-11 Closeout Submittals

Lid Verification Report; G

1.2.1 Underground Detention System

Working drawings shall be required for the system selected by the Contractor.

Working drawings for each underground detention system on the project shall have all appropriate vertical dimensions referenced with elevations that are consistent with the project plans. In addition to any other structural, material or installation requirements, the working drawings shall clearly indicate the following information:

1. The location, dimensions, and volume (capacity) of the storage area within the system.

The working drawing submission by the Contractor shall consist of the following documents:

1. Working drawings for each underground detention system proposed for installation on the project.
2. Copies of the pertinent construction plan, profile, cross section, and detail sheets that have been annotated with any proposed drainage revisions that are required for the installation of the proposed underground detention system. If no changes are required, the submittal shall note same.
3. An Operations and Maintenance Manual the underground detention system describing operations, inspection, maintenance procedures and any applicable warranty information.

Acceptance of the working drawing submission by the Engineer must be obtained by the Contractor prior to the fabrication of each hydrodynamic separator and diversion structure.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and

fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

Subsurface Detention System: Protect chambers from damage and cover the chambers during delivery. Store under tarp to protect from sunlight when time from delivery to installation exceeds one month. Storage should occur on smooth surfaces.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

Subsurface Detention System: Handling is to be performed with equipment appropriate to the size of the chambers and site conditions. Take care to minimize damage to individual chamber components and surrounding assembled chambers.

1.4 SUBSURFACE DETENTION SYSTEM

Furnish And install subsurface storm water treatment and retention system in accordance with the Contract Documents.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C76, Class IV, D-Load.

2.1.1.1 Reinforced Arch Culvert and Storm Drainpipe

Manufactured in accordance with and conforming to ASTM C506, Class A-IV.

2.1.1.2 Reinforced Elliptical Culvert and Storm Drainpipe

Manufactured in accordance with and conforming to ASTM C507. Horizontal elliptical pipe shall be Class HE-IV. Vertical elliptical pipe shall be Class VE-IV.

2.1.2 Poly Vinyl Chloride (PVC) Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, prior to installation of the pipe.

2.1.2.1 Type PSM PVC Pipe

ASTM D3034, Type PSM, maximum SDR 35, produced from PVC certified by the Manufacturer as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.2.2 Profile PVC Pipe

ASTM F794, Series 46, produced from PVC certified by the Manufacturer as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.2.3 Smooth Wall PVC Pipe

ASTM F679 produced from PVC certified by the Manufacturer as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.2.4 Corrugated PVC Pipe

ASTM F949 produced from PVC certified by the Manufacturer as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.3 Polyethylene (PE) Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PE used to manufacture the pipe, prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D3350.

2.1.3.1 Smooth Wall PE Pipe

ASTM F714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.

2.1.3.2 Corrugated PE Pipe

AASHTO M 294, Type S. For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant ligament-stress (NCLS) test meeting the requirements of AASHTO M 294. Pipe walls shall have the following properties:

Nominal Size (inch))	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in. to the 4th/in.)
12	1.5	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116

Nominal Size (inch))	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in. to the 4th/in.)
30	3.92	0.163
36	4.50	0.222
42	4.69	0.543
48	5.15	0.543
54	5.67	0.800
60	6.45	0.800

2.1.3.3 Profile Wall PE Pipe

ASTM F894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 334433C. Pipe walls shall have the following properties:

Nominal Size (inch)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in to the 4th/in)	
		Cell Class 334433C	Cell Class 335434C
18	2.96	0.052	0.038
21	4.15	0.070	0.051
24	4.66	0.081	0.059
27	5.91	0.125	0.091
30	5.91	0.125	0.091
33	6.99	0.161	0.132
36	7.81	0.202	0.165
42	8.08	0.277	0.227
48	8.82	0.338	0.277

2.1.4 Polypropylene (PP) Pipe

Double wall and triple wall pipe with a diameter of 12 to 60 inches shall meet the requirements of ASTM F2736, ASTM F2764/F2764M, or ASTM F2881.

2.2 PERFORATED PIPING

2.2.1 Polyvinyl Chloride (PVC) Pipe

ASTM D2729.

2.2.2 Polypropylene (PP) Pipe

ASTM F2881, Class II perforation patterns.

2.3 DRAINAGE STRUCTURES

2.3.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A929/A929M.

2.3.2 Precast Reinforced Concrete Box

Manufactured in accordance with and conforming to ASTM C1433.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 3000 psi concrete under Section 03 30 00 CAST-IN-PLACE CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C231/C231M. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D1751, or ASTM D1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D1752.

2.4.2 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.4.3 Brick

Brick shall conform to ASTM C62, Grade SW; ASTM C55, Grade S-I or S-II; or ASTM C32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.4.4 Precast Reinforced Concrete Manholes

Conform to ASTM C478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.4.5 Frame and Cover for Gratings

Submit certification on the ability of frame and cover or gratings to carry the imposed live load. Frame and cover for gratings shall be cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.0-T6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.4.6 Joints

2.4.6.1 Flexible Watertight Joints

- a. Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe. The design of joints and the physical requirements for preformed flexible joint sealants shall conform to ASTM C990, and rubber-type gaskets shall conform to ASTM C443. Factory-fabricated resilient joint materials shall conform to ASTM C425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.
- b. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.4.6.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C877.

2.4.6.3 Flexible Watertight, Gasketed Joints

- a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D1056, Type 2 and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of ASTM C990 or ASTM C443. Preformed flexible joint sealants shall conform to ASTM C990, Type B.
- b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable

standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.4.6.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.4.6.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.4.6.6 Corrugated PE Plastic Pipe

Pipe joints shall be water tight and shall conform to the requirements in AASHTO M 294. Water tight joints shall be made using a PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477.

2.4.6.7 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F894.

2.4.6.8 Dual Wall and Triple Wall PP Pipe

Spigot shall have two gaskets meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gaskets are free from debris. Use a joint lubricant available from the manufacturer on the gasket and bell during assembly. ASTM F2881 for 12 to 60 inches pipe diameters shall have a reinforced bell with a polymer composite band installed by the manufacturer. Fittings shall conform to ASTM F2881. Bell and spigot connections shall utilize a spun-on, welded or integral bell and spigot with gaskets meeting ASTM F477.

2.5 STEEL LADDER

Steel ladder shall be provided where the depth of the storm drainage structure exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123/A123M.

2.6 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.

2.7 EROSION CONTROL RIP RAP

Provide non-erodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass

with a minimum thickness of 8 inches unless otherwise indicated.

2.8 SUBSURFACE DETENTION SYSTEM

2.8.1 Geotextile

1. Separation layer between stone and earth fill: AASHTO M288 Class 2 Non-woven geotextile.
2. Stabilization layer under Isolator Row: AASHTO M288 Class 1 Woven geotextile.

2.8.2 Chamber

Injection molded polypropylene resin chambers, resistant to environmental stress cracking. The chambers shall have an open bottom with overlapping corrugation join system. Design live load shall be AASHTO HS 20. Use chamber sizes as specified on the plans. End caps shall be manufactured using similar materials.

2.8.3 Stone Backfill

1" washed, crushed stone conforming to Section M.01 RI DOT Standard Specifications.

2.8.4 Non-Vehicular Traffic Areas. Top Backfill

Use 6" minimum suitable compactable fill to 85% Proctor density.

2.8.5 Vehicular Traffic Areas. Top Backfill

Use 18" minimum depth of cover over chambers to the underside of the pavement to achieve load rating. A maximum depth of 8 feet is allowed from the top of the installed chambers to the finished surface. Compact fill above chambers in 6" lifts to 95% proctor density.

2.8.6 Utility Marker

Use metallic tape as an outline for the entire chamber area to mark the area for future utility detection.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 23 00.00 20 EXCAVATION AND FILL and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 24 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheet piling and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be

necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 31 23 00.00 20 EXCAVATION AND FILL .

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in granular material minimum 4 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. Bell holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Plastic Pipe

Bedding for PVC, PE, SRPE and PP pipe shall meet the requirements of ASTM D2321. Use Class IB or II material for bedding, haunching, and initial backfill. Use Class I, II, or III material for PP pipe bedding, haunching and initial backfill.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe, excluding SRPE pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and

alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (percent)
Corrugated Steel and Aluminum	5
Concrete-Lined Corrugated Steel	3
Plastic (PVC, PE, SRPE, and PP)	5

Note post installation requirements of paragraph DEFLECTION TESTING in PART 3 of this specification for all pipe products including deflection testing requirements for flexible pipe.

3.3.1 Concrete, PVC, Ribbed PVC, Ductile Iron and Cast-Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Elliptical and Elliptical Reinforced Concrete Pipe

The manufacturer's reference lines, designating the top of the pipe, shall be within 5 degrees of a vertical plane through the longitudinal axis of the pipe, during placement. Damage to or misalignment of the pipe shall be prevented in all backfilling operations.

3.3.3 PE, SRPE, and Dual Wall and Triple Wall PP Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's guidelines.

3.3.4 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

3.4 JOINTING

3.4.1 Concrete

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established grade line, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned

with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions shall be cut off flush with the inner surface of the pipe. If non-mastic-type sealant material is used, the "Squeeze-Out" requirement above will be waived.

3.4.1.3 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.4 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible,

watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint of concrete pipe or has reached an elevation of at least 12 inches above the top of the pipe for flexible pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 12 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 12 inches. Use select granular material for this entire region of backfill for flexible pipe installations.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

- a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.
- b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.
- c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.8 FIELD PAINTING

3.8.1 Cast-Iron Covers, Frames, Gratings, And Steps

After installation, clean cast-iron, not buried in masonry or concrete, of mortar, rust, grease, dirt, and other deleterious materials to bare metal and apply a coat of bituminous paint.

3.9 FIELD QUALITY CONTROL

3.9.1 Tests

Testing is the responsibility of the Contractor. Perform all testing and retesting at no additional cost to the Government.

3.9.1.1 HYDROSTATIC TEST ON WATERTIGHT JOINTS

Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed.

3.9.1.1.1 Concrete, PVC, PE, SRPE and PP Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to ASTM C990 or ASTM C443. Test requirements for joints in PVC, PE, and PP plastic pipe shall conform to ASTM D3212.

3.9.1.2 Leakage Test

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate, prior to completing backfill. Low pressure air testing for concrete pipes shall conform to ASTM C969. Low pressure air testing for plastic pipe shall conform to ASTM F1417. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C828 or ASTM C969, after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 0.2 gallons per inch in diameter per 100 feet of pipeline per hour.

3.9.1.3 Determination of Density

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D2167 or ASTM D6938. When ASTM D6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D6938 results in a wet unit weight of soil and ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D6938. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.9.1.4 Deflection Testing

Conduct deflection test no sooner than 30 days after completion of final backfill and compaction testing. Clean or flush all lines prior to testing. Perform a deflection test on entire length of installed flexible pipeline upon completion of work adjacent to and over the pipeline, including backfilling, placement of fill, grading, paving, placement of concrete, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed limits in paragraph PLACING PIPE above as percent of the average inside diameter of pipe. Use a laser profiler or mandrel to determine if allowable deflection has been exceeded.

3.9.1.4.1 Laser Profiler

Inspect pipe interior with laser profiling equipment. Utilize low barrel distortion video equipment for pipe sizes 48 inches or less. Use a camera with suitable lighting to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally. The camera must be able to pan and tilt to a 90 degree angle with the axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition. The video image shall be clear, focused, and relatively free from roll static or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe. For initial post installation inspections for pipe sizes larger than 48 inches, a visual inspection shall be completed of the pipe interior.

3.9.1.4.2 Mandrel

Pass the mandrel through each run of pipe by pulling it by hand. If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, stop and begin test from the opposite direction. The mandrel must meet the Pipe Manufacturer's recommendations and the following requirements. Provide a Mandrel that is rigid, nonadjustable, has a minimum of 9 fins, pulling rings at each end, and is engraved with the nominal pipe size and mandrel outside diameter. The mandrel must be 5 percent less than the certified-actual pipe diameter for Plastic Pipe, 5 percent less than the certified-actual pipe diameter for Corrugated Steel and Aluminum, 3 percent less than the certified-actual pipe diameter for Concrete-Lined Corrugated Steel and Ductile Iron Culvert. The Government will verify the outside diameter(OD)of the Contractor provided mandrel through the use of Contractor provided proving rings.

3.9.2 Inspection

3.9.2.1 Post-Installation Inspection

Visually inspect each segment of concrete pipe for alignment, settlement, joint separations, soil migration through the joint, cracks, buckling, bulging and deflection. An engineer must evaluate all defects to determine if any remediation or repair is required.

3.9.2.1.1 Concrete

Cracks with a width greater than 0.01 inches. An engineer must evaluate

all pipes with cracks with a width greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required.

3.9.2.1.2 Flexible Pipe

Check each flexible pipe (PE, PVC, PP, Corrugated Steel And Aluminum) for rips, tears, joint separations, soil migration through the joint, cracks, localized bucking, bulges, settlement and alignment.

3.9.2.1.3 Post-Installation Inspection Report

The deflection results and final post installation inspection report must include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

3.9.2.2 Low Impact Development Inspection

Inspect Low Impact Development (LID) features indicated on the design portion of the LID Verification Report. Certify LID features were constructed according to plans and specifications or by submitting as-built drawings in accordance with UFGS 01 78 00 Closeout Submittals. When as-built drawings show deviations to the LID features, document the deviations on the LID Verification Report.

3.9.3 Repair Of Defects

3.9.3.1 Leakage Test

When leakage exceeds the maximum amount specified, correct source of excess leakage by replacing damaged pipe and gaskets and retest.

3.9.3.2 Deflection Testing

When deflection readings are in excess of the allowable deflection of average inside diameter of pipe are obtained, remove pipe which has excessive deflection and replace with new pipe. Retest 30 days after completing backfill, leakage testing and compaction testing.

3.9.3.3 Inspection

Replace pipe or repair defects indicated in the Post-Installation Inspection Report.

3.9.3.3.1 Concrete

Replace pipes having cracks with a width greater than 0.1 inches.

3.9.3.3.2 Flexible Pipe

Replace pipes having cracks or splits.

3.10 PROTECTION

Protect storm drainage piping and adjacent areas from superimposed and external loads during construction.

3.11 WARRANTY PERIOD

Pipe segments found to have defects during the warranty period must be replaced with new pipe and retested.

3.12 SUBSURFACE DETENTION SYSTEM

3.12.1 Installation of Chambers

1. Excavate to the required depths and level the base of the excavated area as per details.
2. Lay the non-woven Class 2 geotextile on the base of the excavation and sidewalls for the chambers. Provide sufficient geotextile to overlap the top of the chambers. Overlap the fabric a minimum of 2 feet.
3. Place and compact the stone base as shown on the details.
4. Install chambers 6" apart in accordance with the manufacturer's instructions. Place stone on the sides and between chambers with care. Do not drive equipment over the chambers until the minimum cover is achieved.
5. Wrap the chambers in geotextile fabric layer from the sides and the top to prevent soil entry into the chambers. Take care to avoid damage to fabric liner material during placement. If damage occurs, replace that portion of geotextile with an undamaged piece.
6. Identify locations of inlet, outlet, inspection ports, and any other penetrations of the liner, securing pipe into side panels and sealing the geotextile fabric. Support pipe in trenches and during backfill operations to prevent damage to liner or pipe.
7. Use suitable mechanical compactor to conduct backfill operations on structure sides with care to avoid damage to liner while providing required compaction forces to the top level of the structure.
8. Place cover backfill in 6" lifts and compact with vibrating plates or walk-behind rollers (do not use drivable rolling compactors) to a minimum of 95%. Take care to place backfill on top of structure and avoid damage to structure or liner, using low-pressure tire or track vehicles. Driving on modules should be avoided until a full 24" base has been placed as cover. The backfill height differential should never exceed 2 feet over adjacent chambers.
9. Ensure that all non-chamber construction traffic be kept away from the limits of excavation until the project is complete and final surface materials are in place.
10. Place surfacing materials, or paving materials over the structure with care to avoid displacement of cover fill and damage to surrounding areas.

3.12.2 Installation of Piping and Structures

Install pipe connections and structures in accordance with the

manufacturer's instruction and as shown on the plans.

-- End of Section --

SECTION 33 51 39

MONITORING WELLS
08/17

PART 1 GENERAL

1.1 UNIT PRICES

Payment for each specified item is made at the contract unit price for that item. Payment includes full compensation for equipment, materials and labor for drilling; removal and disposal of temporary casing, cuttings, and drill fluid; preparation of borehole logs; and sample handling, containers, storage, and testing. Measure depth, logging, installation, casing, riser pipe, and well screen by linear distance. Payment is not allowed for test holes or wells abandoned due to construction practices not in accordance with this specification, or for the convenience of the Contractor. Submit catalog data for the well screen (to include the screen slot size), well casing, riser pipe, filter pack material, Bentonite, cement, centralizers, surface protective covers, well vaults, locking caps, dedicated sampling equipment, and chemical specifications on drill lubricants and tracers, if used. Include any information, written or otherwise, supplied by the manufacturers or suppliers of the above listed items.

1.1.1 Test Holes

If the total depth of the test hole is greater than that specified in the contract for "Test Holes and Samples" due to justifiable site specific conditions and other justifiable reasons, the additional depth is paid for at the contract unit price for "Additional Test Hole Depth." If the test hole is developed into the permanent monitoring well, no separate payment is made for the test hole.

1.1.2 Well Drilling and Sampling

If the total depth of the well is greater than that specified in the contract for "Monitoring Wells and Samples," the additional depth is paid for at the contract unit price for "Additional Test Hole Depth."

1.1.3 Well Casing and Riser Pipe Selection and Installation

Payment is made for length of blank casing actually installed in the well. Payment includes compensation for decontamination and installation of the casing, riser pipe, cap, tail piece (if any), end cap and centralizers; and for the furnishing and installing of the well identification tag with information recorded thereon, or well marking in accordance with contract.

1.1.4 Monitoring Well Screen

Payment is made for monitoring well screen actually installed in the well.

1.1.5 Filter Pack Construction

Filter pack construction is measured by the cubic foot. Payment includes compensation for furnishing, delivering, storage, decontamination,

analytical testing, and installing the filter pack.

1.1.6 Bentonite Seal

The bentonite seal is measured by the cubic foot. Payment includes full compensation for hydrating, and tremieing necessary for the work.

1.1.7 Grout Placement

The cement and/or bentonite grout, used in the annulus above the bentonite seal is paid by the cubic foot used. Payment includes compensation for cement, mixing of the grout, and pumping of grout, bentonite, mixing of bentonite grout, and pumping of bentonite grout, necessary for the work.

1.1.8 Monitoring Well Development

Payment for monitoring well development is made by the hour. Payment includes compensation for pumping, surging, sample photograph, discharge water containers, analysis, and disposal.

1.1.9 Monitoring Well Completion Aboveground

Payment includes compensation for protective covers, keyed-alike padlocks, locking caps, project photographs, concrete well pads, gravel, electrical components, lighting components, fencing, sign(s) and protective steel posts.

1.1.10 Monitoring Well or Test Hole Decommissioning/Abandonment

Permanent decommissioning/abandonment of monitoring wells or test holes is paid for only if it becomes necessary to abandon a well or test hole as specified, and only for work completed and accepted as specified. Payment includes compensation for drilling, casing removal, well sampling, materials, cement, mixing of cement, bentonite, and water, pumping of grout, equipment, removal of foreign objects, and transportation necessary to abandon the well or test hole and for the required well or test hole abandonment records.

1.1.11 Site Cleanup

Separate payment is not made for cleanup of the site. Cleanup means restoring the site to its pre-construction condition. Cleanup is considered part of and incidental to the drilling, construction, and/or decommissioning of the monitoring well.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 306

(2010; R 2015) Standard Specification for
Drainage, Sewer, Utility, and Related
Castings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084 (2017) Standard Methods for the
Examination of Water and Wastewater

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M (2020) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

ASTM C117 (2017) Standard Test Method for Materials
Finer than 75-um (No. 200) Sieve in
Mineral Aggregates by Washing

ASTM C136/C136M (2019) Standard Test Method for Sieve
Analysis of Fine and Coarse Aggregates

ASTM C150/C150M (2021) Standard Specification for Portland
Cement

ASTM C387/C387M (2017) Standard Specification for
Packaged, Dry, Combined Materials for
Concrete and High Strength Mortar

ASTM D1452/D1452M (2016) Standard Practice for Soil
Exploration and Sampling by Auger Borings

ASTM D1586/D1586M (2018) Standard Test Method for Standard
Penetration Test (SPT) and Split-Barrel
Sampling of Soils

ASTM D1785 (2015; E 2018) Standard Specification for
Poly(Vinyl Chloride) (PVC), Plastic Pipe,
Schedules 40, 80, and 120

ASTM D2487 (2017; E 2020) Standard Practice for
Classification of Soils for Engineering
Purposes (Unified Soil Classification
System)

ASTM D2488 (2017; E 2018) Standard Practice for
Description and Identification of Soils
(Visual-Manual Procedure)

ASTM D4397 (2016) Standard Specification for
Polyethylene Sheeting for Construction,
Industrial, and Agricultural Applications

ASTM D5088 (2020) Decontamination of Field Equipment
Used at Nonradioactive Waste Sites

ASTM D5092 (2016) Standard Practice for Design and
Installation of Ground Water Monitoring
Wells in Aquifers

ASTM D5521/D5521M (2013) Standard Guide for Development of
Ground-Water Monitoring Wells in Granular
Aquifers

ASTM F480	(2014) Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80
ASTM F883	(2013) Padlocks
FORESTRY SUPPLIERS INC. (FSUP)	
FSUP 77341	(2009) Munsell (R) Soil Color Book
GEOLOGICAL SOCIETY OF AMERICA (GeoSA)	
GSA RCC00100R	(2009) Geological Rock Color Chart (Munsell)
U.S. ARMY CORPS OF ENGINEERS (USACE)	
EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual
U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)	
EPA 530/F-93/004	(1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600-4-89-034	(1990) Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells
EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846	(Third Edition; Update IV) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
29 CFR 1910	Occupational Safety and Health Standards
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

1.3 ADMINISTRATIVE REQUIREMENTS

Ensure each system, including equipment, materials, installation, and performance, is in accordance with local, State, and Federal regulations, ASTM D5092, EPA 600-4-89-034 and DoD policies NAVSTA Newport policies and standards except as modified herein. Consider the advisory or recommended provisions to be mandatory. Reference to the "Project Representative" and the "Owner" is interpreted to mean the Contracting Officer. Additional requirements are included under Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS.

1.3.1 Notification

Notify the Installation Environmental Coordinator (IEC), the DIGSAFE coordinator and the Contracting Officer 30 days prior to drilling. The Installation Environmental Coordinator (IEC) is responsible for contacting the State of Rhode Island and the USEPA in accordance with the applicable reporting requirements.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Investigation-derived Waste Management Plan; G

Installation Plan; G

Health and Safety Plan; G

Treatment, Storage, and Disposal Facility Permit

Qualifications; G

SD-02 Shop Drawings

Survey Maps and Notes; G

Well Construction Drawings; G

SD-03 Product Data

Riser Pipe; G

Cement; G

Surface Protective Covers; G

Well Vaults; G

Locking Caps; G

Well Casing; G

Well Screen; G

Filter Pack; G

Neat Cement Grout; G

Bentonite; G

SD-06 Test Reports

Well Development Record; G

Water Source Analytical Test Results; G

SD-07 Certificates

Permits

Installation Survey Report

Well Development Report

Shipment Manifests

Delivery Certificates

Correspondence

Photographs

Treatment and Disposal Certificates

SD-11 Closeout Submittals

Installation Diagram; G

Well Decommissioning/Abandonment Record

Geophysical Logs

Borehole Logs; G

1.5 QUALITY CONTROL

1.5.1 Qualifications

Submit personnel qualification documentation. Provide an onsite professional geologist (PG) with at least 3 years experience in hazardous waste projects, soil and rock logging, and monitoring well installation. Ensure the geologist is registered in the State of Rhode Island, and responsible for all geophysical and borehole logging, drilling, well installation, developing and testing activities. Provide a driller licensed in the State of Rhode Island, according to State requirements. Perform and provide geophysical log interpretation by a qualified log analyst, demonstrating competence through background, training, and experience when so called upon. Ensure the drill crew is experienced and trained in drilling, and health and safety requirements for contaminated sites.

Furnish documentation proving:

- a. A minimum of 3 years of monitor well installation experience
- b. Appropriate health and safety personnel are on staff as specified in Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES
- c. That qualified personnel are available to perform the necessary chemical sampling as presented in the approved Sampling and Analysis Plan.

1.5.2 Required Drawings

Submit well construction drawings showing components and details of well casing, well screen, filter pack, annular seal, and associated items. Ensure drawings are prepared and sealed by a State certified professional geologist, hydrogeologist, or a State registered professional civil engineer, hereafter referred to as the Contractor's Professional Consultant(CPC).

1.5.3 Investigation-derived Waste Management Plan

Furnish a material handling plan 15 days prior to initiation of the work that describes the plan for handling the investigation-derived waste, including the following: a schedule to be employed in the well drilling and development stages, a sequence of operations, the method of drilling and development, material hauling, proposed equipment, handling of the investigation-derived waste, testing requirements for the investigation-derived waste.

1.5.4 Health and Safety Plan (HASP)

Describe safety precautions for each phase of the project as specifically related to handling of soil and water removed during well drilling and development operations. Identify appropriate requirements of 29 CFR 1910 and EM 385-1-1. Identify safety equipment and procedures available for use during the project. Furnish the name and qualifications based on education, training, and work experience of the proposed Health and Safety Officer (HASO) and the members of the drill crew. The CPC may perform the responsibilities of the HASO if properly qualified.

1.5.5 Installation Plan

Submit a plan, describing the drilling methods, sampling, and monitoring well construction and well development 30 calendar days prior to beginning drilling operations. Provide the plan approved and signed by a geologist experienced in hazardous waste projects as specified in the paragraph QUALIFICATIONS. Incorporate the following requirements into the Monitoring Well Installation Plan and follow in the field. Conduct sampling and testing in accordance with the guidelines as stated in: "Department of Defense Policy and Guidelines for Acquisitions Involving Environmental Sampling or Testing", November 2007. Include in the plan, but do not limit to a discussion of the following:

- a. Description of well drilling methods, and installation procedures, including any temporary casing used, placement of filter pack and seal materials, drill cuttings and fluids disposal, and soil/rock sample disposition.
- b. Description of well construction materials, including well screen, riser pipe, centralizers, tailpiece (if used), filter pack and filter pack gradation, bentonite, drilling fluid additives (if used), drilling water, cement, and well protective measures.
- c. Description of quality control procedures to be used for placement of filter pack and seals in the boring, including depth measurements.
- d. Include sample of forms used for written boring logs, installation diagrams of wells, geophysical logs, well development records, well sampling data records, State well registration forms, and well

abandonment records.

- e. Description of contamination prevention. Describe decontamination procedures for well materials and equipment.
- f. Description of protective cover surface completion procedures, including any special design criteria/features relating to frost heave prevention. Include the maximum frost penetration for the site in this description.
- g. Description of well development methods to be used.
- h. List of applicable publications, including State and local regulations and standards.
- i. List of personnel assignments for this project, and personnel qualifications.
- j. Description of well decommissioning/abandonment procedures.
- k. Description of in-situ permeability determination techniques, if testing is required.
- l. Description and discussion of geophysical techniques to be employed at the site.

1.5.6 Treatment, Storage and Disposal Facility Permit

Submit verification that the proposed treatment facility is permitted to accept the contaminated materials specified, prior to the start of drilling.

1.5.7 Well Development Report

Provide a report, containing the following data for each well: project name and location, well designation, date and time of well installation, date and time of well development, static water level from top of well casing before development and 24 hours after development, field measurements of pH, temperature, and specific conductivity, depth of well from top of casing to bottom of well, screen length, description of development methodology size/capacity of pump or bailer, pumping rate, and recharge rate.

1.5.8 Shipment Manifests

Furnish copies of manifests and other documentation required for shipment of waste materials within 24 hours after removal of waste from the site.

1.5.9 Delivery Certificates

Submit verification that the wastes were actually delivered to the approved treatment facility, within 7 days of shipment.

1.5.10 Treatment and Disposal Certificates

Submit verification that the wastes were successfully disposed of.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in an undamaged condition. Unload and store with minimal handling. Store materials in on-site enclosures or under protective coverings. Store plastic piping and jointing materials, and rubber gaskets under cover, out of direct sunlight. Store materials off the ground. Keep insides of pipes and fittings free of dirt and debris. Replace defective or damaged materials with new materials.

1.7 PROJECTS/SITE CONDITIONS

Access to each monitoring well site, including any utility clearance, permits, licenses, or other requirements and the payment thereof necessary for execution of the work is the responsibility of the Contractor.

Submit a copy of all permits, licenses, or other requirements necessary for execution of the work to the Contracting Officer. Before beginning work, notify local United States Environmental Protection Agency (USEPA), and the Rhode Island Department of Environmental Management (RIDEM) of the type and location of wells to be constructed, the method of construction and anticipated schedule for construction of the wells. Furnish a copy of all such well site correspondence to the Contracting Officer.

Obtaining rights-of-entry is the responsibility of the Contractor. Visit each proposed well location to observe any condition that may hamper transporting equipment or personnel to the site. If relocation is necessary, the Contractor, Installation Environmental Coordinator, and the Contracting Officer will agree on a suitable clearing, or relocation plan and the location of any required access road.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Construct each monitoring well to yield chemically representative ground water samples from the screened interval for chemical analysis, and to allow for the accurate measurement of ground water depths relative to the top of the well riser, by use of electrical, wetted tape, or acoustical methods. The screened interval is that portion of a monitoring well which is directly open to the host aquifer by way of openings in the well screen and indirectly open to the aquifer by way of the filter pack (or other permeable material) extending continuously below and/or above the screen.

Overburden or weathered bedrock wells shall be constructed with 10-foot schedule 40 polyvinyl chloride (PVC) screens and filter pack consisting of silica sand. Sand shall be placed to a depth of one foot above the screened interval. Above the sand a minimum of one foot of bentonite chips shall be placed and hydrated in place to seal off the screened interval.

Drill cuttings determined by the field geologist to have volatile organic chemicals (VOCs) measured by a photoionization detector (PID) less than 20 parts per million by volume (ppmV) shall be used to fill annular space above the bentonite seal to a depth of 6 to 8 inches below ground surface (bgs).

The surface casing will consist of a well stick-up or flush-mount road box, whichever is most appropriate for the particular area; both surface finishes shall be encased in a minimum 18- by 18-inch concrete pad with a

minimum 6-inch thickness.

2.2 COMPONENTS

2.2.1 Well Casing

2.2.1.1 PVC Pipe

Use ASTM F480, Type 1, Grade 1, PVC 12454, NSF wc or NSF pw, Schedule 40 pipe, with flush threaded joint fittings. Wrap threaded joints with fluoropolymer tape, and provide with nitrile O-ring gaskets.

2.2.2 Well Screen

2.2.2.1 PVC Screens

Provide a well screen consisting of new commercially fabricated flush-joint threaded 2 inch nominal internal diameter polyvinyl chloride (PVC) schedule 40 0.010-inch slotted, non-clogging design. Use screens conforming to ASTM D1785, PVC 1120, NSF wc or NSF pw, Schedule 40, screen, Schedule 80, machine-slotted construction, flush threaded joint ends. Ensure slots are even in width, length, and separation. Provide required fittings conforming to ASTM F480, flush thread male by female. Provide a screen slot size 0.010-inch, and screen length of 10. Seal the bottom section of the screen watertight by means of a flush threaded end cap of the same material as the well screen, within 6 inches of the open portion of the screen.

2.2.3 Primary Filter Pack

Provide clean, durable, well-rounded and well sorted, chemically inert and washed glass beads or silica-based sand or gravel of uniform grain size. Ensure the filter pack does not contain organic matter or friable materials and allow free flow of water in the well, and also prevent the infiltration of aquifer materials. Ensure the filter pack has a 30 percent finer than (d-30) grain size of that is 4 to 10 times greater than the d-30 grain size of the aquifer and a uniformity coefficient less than 2.5, in accordance with ASTM C117 and ASTM C136/C136M. The appropriate grain size of the filter pack will be determined by the field geologist after review of the geological material in the screened zone of each monitoring well. 2.2.3.1 Secondary Filter Pack

Ensure gradation is in accordance with ASTM D5092. Provide clean, durable, well-rounded, and well sorted, chemically inert and washed glass beads or silica-based sand or gravel of uniform grain size. Pack cannot contain organic matter or friable materials.

2.2.4 Annular Sealants

2.2.4.1 Bentonite Seal

Provide powdered, granular, uncoated pelletized, or chipped sodium montmorillonite in sealed containers from a commercial source, free of impurities. Ensure pellet size is less than one fifth the diameter of the borehole annular space to prevent bridging. Ensure bentonite base grout is in accordance with ASTM D5092.

If the bentonite seal is located above any borehole fluid levels, place a layer of fine sand at the top of the bentonite seal, to provide an

additional barrier to any downward migration of grout.

2.2.4.2 Neat Cement Grout

Provide neat cement grout in accordance with ASTM D5092. Ensure cement is in accordance with ASTM C150/C150M. Quick setting admixtures are not allowed. Do not use drilling mud or cuttings as a sealing material.

2.2.4.3 Cement And Bentonite Grout

Provide cement grout with a mixture of a maximum of 7 gallons of approved water per 94 lb bag of portland cement, conforming to ASTM C150/C150M, Type I. Add no more than 5 percent by weight of bentonite powder to reduce shrinkage and hold the cement in suspension prior to the grout set. Use sodium bentonite powder and/or granules for high-solids bentonite grout.

2.2.5 Bottom Plugs

Provide a flush threaded solid plug at the bottom of the well. Ensure plug material is the same as the well casing or screen to which it is attached. Wrap joints with fluoropolymer tape and provide nitrile O-ring gaskets.

2.2.6 Locking Well Cap

Provide a flush threaded, weatherproof, and non-removable locking well cap on the top of the well. Ensure the well cap is the same material as the well casing to which it is attached.

2.2.7 Protective Outer Casing and Bollards

Install a protective outer casing and bollards with pipes conforming to ASTM A53/A53M, Type E or S, Grade B.

2.2.8 Polyethylene Sheeting

Ensure polyethylene sheeting conforms to ASTM D4397.

PART 3 EXECUTION

Notify the Contracting Officer at least 15 days prior to commencement of work. Well locations are as indicated. Drilling, installation, and development of the monitoring wells is supervised, directed, and monitored by the geologist in charge. Decontaminate equipment used for drilling, sampling, and well development before and after each use in accordance with ASTM D5088.

3.1 PREPARATION

3.1.1 Water Source

If well drilling and installation requires the use of water, prior to its use at the site, locate and obtain water from a source. Sample and test the water source for the constituents specified in the Sampling and Analysis Plan. Submit the water source analytical test results to the Contracting Officer and obtain approval to use the source water. Transport and store the water at the site.

3.1.2 Decontamination

Clean the drill rig, drill rods, drill bits, augers, temporary casing, well developing equipment, tremie pipes, grout pumping lines, and other associated equipment with high-pressure hot water and steam prior to drilling at each monitoring well location. Perform decontamination in accordance with ASTM D5088, at a central decontamination station located in an area that is remote from, and cross- or down-gradient from the well being drilled.

Clean the screen and well casing with high-pressure hot water and detergent cleaning solution immediately prior to installation in the well. The use of factory sealed (plastic wrapped) screen and well casing does not waive this requirement for pre-installation cleaning. Decontaminate samplers in accordance with the Sampling and Analysis Plan.

3.1.3 Decontamination Station

- a. Construct a temporary decontamination pad onsite, bermed and slightly inclined towards a sump located in one of the back corners of the pad. Line the pads and berms with plastic sheeting to contain decontamination water. Place exterior-grade plywood sheeting over the plastic sheeting to prevent damage to the plastic and allow the drill rig and heavy equipment to use the pad.
- b. Make the minimum dimensions of the pad the length and width of the drill rig, plus 4 feet per side to allow access and steam cleaning. Use yellow ribbon to encircle the decontamination pad.
- c. Pump water collected in the sump to a 55 gallon drum labeled "Decontamination Pad Sump Water." Transfer solid waste to a separate 55 gallon drum labeled "Decontamination Pad Sump Sludge."

3.1.4 Containerization Of Development Water, And Drill Cuttings

Furnish D.O.T. approved polyethylene or steel drums or vessels with lids, lid gaskets, bolts, chain of custody forms and drum labels. Mark each drum label in accordance with 49 CFR 172 in addition to the following information:

- a. Drum number,
- b. Site name,
- c. Well name and number,
- d. Contents and date,
- e. Approximate depth of material contained in each drum, and
- f. The name and phone number of the Installation Environmental Coordinator (IEC) and Hazardous Waste Manager.

3.2 INSTALLATION

Install the well in accordance with ASTM D5092 and EPA 600-4-89-034, and as indicated on the well construction drawings submitted by the CPC and approved by the Contracting Officer.

Prevent aquifer contamination by the drilling operation and equipment, intra- and inter-aquifer contamination, and vertical or horizontal seepage of surface water adjacent to the well into the subsurface, especially the monitoring well intake zone. Perform work in conformance with EPA 530/F-93/004, EPA 600/4-79/020, EPA SW-846, and EM 385-1-1.

Ensure the borehole is stable and verified straight before beginning installation.

3.2.1 Drilling Method

- a. Use a drilling method which prevents the collapse of formation material against the well screen and casing during installation of the well. Size the inside diameter of any temporary casing used sufficient to allow accurate placement of the screen, riser, centralizer, filter pack, seal and grout.
- b. The use of drilling aids such as bentonite, other clay-based agents, or any other foreign matter capable of affecting the characteristics of the ground water is prohibited. Ensure any drilling fluid additive used is inorganic in nature. Grease or oil on drill rods, casing, or auger joints are not permitted; however, PTFE tape or vegetable oil (in solid phase form) are acceptable. Submit manufacturer's data, if available, including analytical test results of the additive, if not a part of the manufacturer's data.
- c. Provide a drill rig free from leaks of fuel, hydraulic fluid, and oil which may contaminate the borehole, ground surface or drill tools. During construction of the wells, use precautions to prevent tampering with the well or entrance of foreign material. Prevent runoff from entering the well during construction. If there is an interruption in work, such as overnight shutdown or inclement weather, close the well opening with a watertight uncontaminated cover. Secure the cover in place or weighted down so that it cannot be removed except with the aid of the drilling equipment or through the use of drill tools.

Advance borehole using conventional 8 1/4 inch hollow-stem auger drilling methods. If it is the opinion of the geologist in charge that an alternate drilling method is required, submit justification for a boring method change to the Contracting Officer, and receive approval for the change granted prior to drilling.

3.2.2 Test Hole Requirements

Drill one test hole for every monitoring well or well cluster installed. A well cluster, as defined in this specification, is two or more wells completed (screened) to different depths in a single borehole or in a series of boreholes in close proximity (10 feet or less) to each other. The test hole may be converted to the permanent monitor well. Log test holes in accordance with paragraph BOREHOLE LOGS, and if temporary casing is used, use in accordance with paragraph DECONTAMINATION.

3.2.3 Borehole Diameter and Depth

Provide sufficient diameter in borings for monitoring well installation to allow at least 2 inches of annular space between the borehole wall and all sides of the centered riser pipe and screen. Determine depths of individual borings as specified in the approved Monitoring Well Installation Plan, with actual depth adequate to allow for the collection

of representative ground water samples for chemical analysis at the time of initial sampling.

3.2.4 Screen, Well Casing And Riser Pipe Placement

Locate well screens as indicated. Ensure the length of each screen is as indicated. Distribute slotted openings uniformly around the circumference of the screen. Ensure the open areas approach the formation's natural porosity.

Ensure personnel wear clean cotton or surgical gloves while handling the assembly. Ensure well casings, screens, plugs, and caps are decontaminated prior to delivery by the manufacturer and certified clean. Deliver, store, and handle materials in such a manner as to ensure that grease, oil, or other contaminants do not contact any portion of the well screen and casing assembly prior to installation.

- a. Provide the monitoring well screen in the prescribed length with specified bottom cap securely attached, set to the appropriate depth.
- b. Place the bottom of the well screen no more than 3 feet above the bottom of the drilled borehole.
- c. Clean the screen and well casing and riser pipe with high pressure hot water/steam just prior to installation; allowing no foreign material to remain on the screen and well casing before installation. The use of factory-sealed (plastic wrapped) screen, free from painted markings, does not waive requirements for pre-installation cleaning. Place the well screen as specified on the drawings. Ensure the well casing and riser pipe extends upwards from the screen to an elevation appropriate for the surface completion described in paragraph PROTECTIVE COVER PLACEMENT. Do not allow the well screen and riser pipe to drop or fall uncontrolled into the borehole.
- d. Join the screen and well casing and riser pipe sections by flush threaded watertight joints and fastenings. Solvent glue or set screws are not permitted.
- e. Use centralizers as necessary to ensure that the well screen and casing assembly is installed concentrically in the borehole. Center and plumb the well by the use of a minimum of one stainless steel centralizers, spaced at intervals not exceeding 20 feet along the length of the casing. Do not place centralizers on the screened interval or within the bentonite seal. Verify the alignment of the well by passing a 5 foot long section of rigid pipe 1/4 inch smaller in diameter than the inside diameter of the casing through the entire well. If the pipe does not pass freely, the well is not accepted. Thoroughly clean the pipe section with high pressure hot water prior to each test. Use temporary casing, hollow stem augers or other measures, as necessary, to prevent collapse of the boring against the well screen and well casing and riser pipe prior to placement of the filter pack and sealing materials. Install a cap on the top of the riser pipe, either vented, or a telescopic fit, constructed to preclude binding to the well casing caused by tightness of fit, unclean surfaces, or weather conditions. Make cap secure enough to preclude the introduction of foreign material into the well, yet allow pressure equalization between the well and the atmosphere.

When the assembly has been installed at the appropriate elevation,

adequately secure the assembly to preclude movement during placement of the filter packs and annular seals. Cap the top of the well casing during filter pack placement.

3.2.5 Filter Pack Placement

Protect filter pack material from contamination prior to placement by either storing it in plastic lined bags, or in a location protected from the weather and contamination on plastic sheeting. Transport filter pack material to the well site in a manner which prevents contamination by other soils, oils, grease, and other chemicals.

Prior to commencement of work, receive approval from the Contracting Officer for equipment and methods required to place filters. Place primary and secondary filter packs as indicated on the approved well construction drawings to fill the entire annular space between the screen and casing assembly and the outside wall of the borehole. Place both the primary and secondary filters with a tremie pipe in accordance with EPA 600-4-89-034 and ASTM D5092. Placement of the primary and secondary filters by gravity or free fall methods is not allowed. Control speed of filter placement to prevent bridging and to allow for settlement. Take frequent measurements inside the annulus during tremie pipe retraction to ensure that the filter pack is properly placed.

Dumping filter pack material from the surface of the ground and agitating the well in an effort to settle the filter material is not allowed. Install the filter pack continuously and without interruption until the filter pack has been placed to a minimum of 3 feet above the top of the screen in the monitoring well. Directly measure the depth to the top of the filter pack and record. Obtain any additional water required to be added to the filter pack material in accordance with paragraph WATER SOURCE.

3.2.6 Bentonite Seal

3.2.6.1 Bentonite Pellets

Pouring of pellets is acceptable in shallow boreholes less than 40 feet. In order to provide accurate measurement of bentonite pellet thickness in the well boring, tamp the pellet seal during measurement. If not placed in lifts, allow the seal a minimum hydration time of three hours, unless the manufacturer recommends a longer hydration time.

3.2.6.2 Bentonite Chips

Adequate annular space is required in the use of bentonite chips to reduce the risk of bridging. Chips are preferable to use over pellets when installing a seal in a deep water column. In order to provide accurate measurement of bentonite chip seal thickness in the well boring, tamp the seal during measurement. If not placed in lifts, allow the seal a minimum hydration time double the hydration time for pellets.

3.2.6.3 Bentonite Slurry

A bentonite slurry seal can be used when the seal location is too deep for the use of pellets or chips, or within a narrow borehole annulus. The slurry is made from granular or powder sodium bentonite. The specific gravity of cement grout placed atop a slurry seal will be greater than the bentonite slurry. Exercise care to preclude the grout from migrating

downward into the slurry.

Mix water from an approved source with granular or powder bentonite to form a thick bentonite slurry, consisting of a mixture of bentonite and the manufacturer's recommended volume of water to achieve an optimal seal. A typical slurry mix contains at least 20 percent solids by weight and has a density of 9.4 lb per gallon of water or greater.

3.2.6.4 Bentonite Seal Thickness And Replacement

Place a minimum 3 foot thick hydrated bentonite seal on top of the filter pack. Control speed of bentonite placement to prevent bridging of pellets or chips, or segregation of slurry. Place Bentonite chips and pellets in lifts of 6 inches to 1 foot with each lift allowed to hydrate for a minimum of 30 minutes prior to placing the next lift. If not placed in lifts, the minimum hydration time for pellets is 3 hours, unless manufacturer recommendations for hydration are longer. The hydration time for chips can require twice the time required for pellets. Directly measure the depth to the top of the bentonite seal and record immediately after placement, without allowance for swelling. Add water to the annular space as directed by the geologist in charge to ensure complete hydration of the bentonite. If the bentonite seal is located above any borehole fluid levels, place a 1 foot layer of fine sand at the top of the bentonite seal.

3.2.7 Grout Placement

Mechanically mix a high-solids bentonite grout, and place in one continuous operation into the annulus above the bentonite seal to within 40 inches of the ground surface. Make grout injection in accordance with ASTM D5092. If the casing interval for grouting is less than 15 feet, and without fluids after any drill casing is removed, place the grout either by pouring or pumping.

Place cement grout in the annular space above the bentonite seal as indicated on the well construction drawings. Place the cement grout as a slurry through a tremie pipe, and inject from the bottom up. Inject grout in one continuous operation until full strength grout flows out at the ground surface without evidence of drilling cuttings or fluid. Cure grout a minimum of 48 hours before beginning well development operations.

Add additional grout from the surface to maintain the level of the grout at the land surface as settlement occurs. Work is not permitted in the well within 48 hours after cement grouting.

Thoroughly clean the tremie pipe with high pressure hot water/steam before use in each well.

3.2.8 Ground Surface Seal

Construct monitoring wells with a continuous pour concrete ground surface seal. Extend the ground surface seal to a minimum of 40 inches below ground surface to avoid frost heaving and to anchor the well, unless the seal would interfere with proper placement or functioning of the well screen or a road box. Flare the ground surface seal such that the diameter at the top is greater than the diameter at the bottom. Slope the top of the ground surface seal away from the well casing and construct the seal to be large enough to allow drainage away from the well.

3.2.9 Concrete or Gravel Pad Placement

Construct a concrete pad with a minimum radius of 2 feet from the protective casing and 4 inch thick, sloped away from the well around the well casing at the final ground level elevation. Furnish pre-packaged, dry, combined concrete materials for the well pads conforming to ASTM C387/C387M normal weight, normal strength concrete. Combine the dry materials with potable water and mix in an approved mixer or container until uniform in consistency and color. Limit water to the minimum amount possible.

3.2.10 Protective Cover Placement

Provide all monitoring wells with a steel lockable protective enclosure set in the annular seal over the well casing with keyed-alike locks on the protective covers for all wells.

3.2.10.1 Aboveground Completions

Provide protective outer casing around the well casing extending above grade. The diameter of the protective outer casing is a minimum of 4 inches larger than the well casing diameter. The top of the protective outer casing extends a minimum of 6 inches above the top of the well casing cap. Set the protective outer casing in cement grout and extend the bottom of the protective well casing below the depth of the frost line. Drill a 1/4 inch diameter weep hole in the protective outer casing 3 inches above the ground surface. Fill the annular space between the protective outer casing and the well casing with dry bentonite pellets, granules, or chips. Place coarse sand or washed pea gravel or both above the dry bentonite to a depth covering the drain hole.

Provide 6 inch diameter steel pipe bollards, filled with concrete as indicated to protect the exposed well head.

Provide cap on top of the protective outer casing. Ensure cap is flush threaded and of the same material as the protective outer casing. Wrap threaded joints with fluoropolymer tape and provided with nitrile O-ring gaskets.

Ensure the well cap can accommodate a padlock. Provide a long shackled padlock in accordance with ASTM F883. Provide two padlock keys to the Contracting Officer. Ensure locks at the well site are keyed alike.

3.2.10.2 At-Grade Completions

Provide cast iron vault box, 12 inch diameter, with watertight frame and cover. Select vault loading support for AASHTO M 306 H-20 loading for traffic areas. Depth of frame is 6 inches. Set the frame in a concrete collar with a minimum thickness of 8 inches, and extending 4 inches beyond the edge of the frame in all directions. Ensure the frame and concrete collar is set flush with the level of the existing pavement. Provide a locking well cap on top of the well casing, which terminates inside the vault as indicated.

3.2.10.3 Protective Steel Casing for Aboveground Completions

- a. Install a protective steel casing around the well casing and riser pipe by placing the protective casing into the annular seal. Clean the protective casing with high-pressure hot water/steam prior to

installation to ensure that it is free of any contamination. Provide a protective casing with an inside diameter of at least 4 inches greater than the nominal diameter of the well riser. Fit the protective casing with a locking cap and install so that there is a maximum 0.2 foot clearance between the top of the in-place inner well casing cap and the bottom of the protective casing locking cap when in the locked position.

- b. Position and maintain the protective casing in a plumb position. Extend the bottom of the protective casing a minimum of 2.5 feet below the top of the ground surface; extending a minimum of 2.5 feet below the maximum depth of frost penetration (frost line); and anchored into the cement grout annular seal; and also extending at least 2.5 feet above the surface of the ground. Seal and immobilize the protective casing in concrete placed around the outside of the protective casing, then place dry bentonite pellets, or granules, in the annular space below ground level within the protective casing.
- c. Provide the protective casing with a 1/4 inch diameter drain hole installed just above the top of the concrete pad. Place coarse sand or pea gravel in the annular space between the protective casing and the riser pipe, above the drain hole, to within 3 inches from the top of the riser pipe. Install four protective steel posts, located 4 feet from the well, equally spaced around the concrete pad. Fill the steel posts with cement. Do not install the posts in the concrete pad, but a 0.5-1.0 foot distance from the edge of the concrete pad. Set the posts in cement, and extending a minimum of 3 feet above the ground surface, with at least one third of the posts' total length below ground surface.

3.2.10.4 Flush-to-Ground Utility Vault

Install a flush-to-ground protective steel utility vault or manhole around the well casing and riser pipe which has been cut off below grade. Construct the flush mounted protective utility vault or manhole with a concrete ground surface seal. Extend the ground surface seal to, but not beyond, the total depth of the flush mounted protective utility vault. Install the ground surface seal around the flush mounted protective utility vault but do not place between the flush mounted protective utility vault and the well casing. Do not install the flush mounted protective utility vault in areas subject to ponding or flooding. Provide the wording "ground water monitoring well" on the flush mounted protective cover's lid or manhole cover on its outer surface. Install flush mounted protective utility vaults through an impervious surface such as asphalt or concrete. If an impervious surface does not exist, create one to support the weight of the traffic in the area. Provide a flush mounted protective utility vault consisting of a watertight metal casing with an inside diameter at least 4 inches greater than the inside diameter of the monitoring well casing, made of one continuous metal piece or two metal pieces which are joined with a continuous weld; and a minimum length of 12 inches. Allow no more than 8 inches between the top of the monitoring well casing and the top of the flush mounted protective utility vault after installation. Provide the flush mounted protective utility vault with an exterior flange or lugs. Do not allow the flush mounted protective utility vault to extend below the top of the cement/bentonite annular space seal. To prevent damage from frost heave, extend the concrete surrounding the utility vault a minimum of 12 inches below the frost line. Provide the flush mounted protective utility vault or the monitoring well with a locking mechanism and a watertight cap.

Within 7 days of completion of each well, but no sooner than 48 hours after cement grouting is completed, develop the well. Perform development using only mechanical surging or over pumping or a combination thereof in accordance with ASTM D5521/D5521M. Include details of the proposed development method in the Well Installation Plan. Maintain a well development record in accordance with paragraph WELL DEVELOPMENT RECORDS. Development is complete when:

- a. Well water is clear to the unaided eye,
- b. Sediment thickness in the well is less than 1 percent of the screen length,
- c. A minimum of three times the standing water volume in the well plus three times the volume of all added water and drilling fluid lost during drilling and installation of the well is removed, and
- d. Stabilization has occurred for the following parameters: temperature, specific conductivity, pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity readings, measured before, twice during and after development operations. Stabilization means variation of less than 0.2 pH units, variation of plus or minus 1 degree Fahrenheit, plus or minus 3 percent change in specific conductance; plus or minus 10mV for ORP; and plus or minus 10 percent for DO, and turbidity is less than 5 nephelometric turbidity units (NTUs), measured between three consecutive readings with one casing volume of water removed between each reading. Determine ORP in accordance with AWWA 10084. Conduct temperature, specific conductance, DO, turbidity, and pH readings in accordance with EPA 600/4-79/020. At completion of well development, collect approximately 1 pint of well water in a clear glass jar. Label the jar with project name, well number and date; and digitally photograph. Suitably backlight the subject in the photograph close-up to show the clarity of the water and any suspended sediment. The photograph is a part of the well development record. Contain water removed during development and testing operations in D.O.T. approved drums, containers or vessels and dispose of properly based on waste characterization and profiling, in accordance with paragraph CONTAINERIZATION OF DEVELOPMENT WATER, AND DRILL CUTTINGS, and DRILLING WASTE DISPOSAL.

3.3.3.1 Well Development Records

Prepare and submit a monitoring well development record for each monitoring well installed under the supervision of the geologist present during well installation operations, within 20 working days of the completion of development. Include the following information on the well development record, but do not limit to the following:

- a. Date, time, and elevation of water level in the well, before development.
- b. Depth to bottom of well, name of project and site, well identification number, and date of development.
- c. Method used for development, to include size, type and make of equipment, bailer, and/or pump used during development.
- d. Time spent developing the well by each method, to include typical

pumping rate, if pump is used in development.

- e. Volume and physical character of water removed, to include changes during development in clarity, color, particulates, and odor.
- f. Volume of water added to the well, if any.
- g. Source of any water added to the well.
- h. Volume and physical character of sediment removed, to include changes during development in color, and odor.
- i. Clarity of water before, during, and after development. Nephelometric turbidity unit (NTU) measurements.
- j. Total depth of well from top of the casing and the static water level, immediately after pumping/development, and 24 consecutive hours after development.
- k. Readings of pH, specific conductance, DO, ORP, and temperature taken before, during, and after development.
- l. Name and job title of individual developing well.
- m. Name and/or description of the disposal facility/area, for the waters removed during development.

3.3.4 Surveys

Establish coordinates and elevations for each monitoring well/test hole. Determine horizontal coordinates to the closest 1.0 foot and referenced to the State Plane Coordinate System, or Universal Transverse Mercator (UTM). If the State Plane Coordinate System/UTM is not readily available, use an existing local grid system. Obtain a ground elevation to the closest 0.1 foot at each well. The highest point on the top of the riser pipe serves as a measurement point; reference this elevation and survey to the nearest 0.01 foot using the National Geodetic Vertical Datum of 1988. If the datum is not readily available, use the existing local vertical datum. Plot the location, identification, coordinates, and elevations of the well and monuments on maps by a registered land surveyor licensed in the State of Rhode Island, with a scale large enough to show their location with reference to other structures. Submit this data with a well location map as the Installation Survey Report.

3.3.4.1 Survey Maps and Notes

Prepare and submit a tabulated list of all monitoring wells and monuments, copies of all field books, maps showing the locations, and elevations of all monitoring wells, and all computation sheets, consisting of the designated number of the well or monument, the X and Y coordinates, and all the required elevations within 20 working days after completion of the survey.

3.3.5 Project Photographs

Submit digital photographs taken before, during, and after completion of the work, of each well installation site. Also take photographs of any rock that is cored at the site; take a minimum of one view of each well installation. If rock is cored at the site, after the core has been

logged, dampen the core if it has dried, neatly arrange in the core box, and take color photographs. Document the following information:

Project No. Contract No.

Contractor/Photographer:

Photograph No. Date/Time:

Description:

Direction of View:

3.4 ADJUSTING AND CLEANING

3.4.1 Site Cleanup

After completion of the work, remove tools, appliances, surplus materials, temporary drainage, rubbish, and debris incidental to work. Backfill excavation and vehicular ruts and dress to conform with the existing landscape or terrain. Repair or replace utilities, structures, roads, fences, or any other pre-existing item damaged due to negligence. Accomplish repair or replacement prior to completion of this contract.

3.4.2 Water From Well Development Operations

Water generated during well installation will be containerized and properly characterized in accordance with State and local regulations, the SAP, and as designated by the hazardous waste and wastewater Program Managers. Determine disposal method based on the characterization of the water and recommendations from the Program Managers.

3.4.2.1 Disposal of Containerized Water

Sample and analyze water as described in the SAP. Dispose of all water off-site at a permitted disposal facility.

3.4.3 Drilling Waste Disposal

Dispose of slurry, drill cuttings, rock core; other solid or liquid material bailed, pumped, or otherwise removed from the borehole during drilling, installation, completion, and well development procedures; and fluids from material/equipment decontamination activities based on waste characterization and profiling as accepted by the disposal facility. Dispose of all derived wastes at an off-site, permitted facility and characterized in accordance with disposal facility requirements.

3.4.4 Transportation Of Contaminated Soil And Water

Comply with Federal, State, and local requirements for transporting contaminated materials through the applicable jurisdictions and bear responsibility and cost for any noncompliance. In addition to those requirements, do the following:

- a. Inspect and document vehicles and containers for proper operation and covering.
- b. Inspect vehicles and containers for proper markings, manifest documents, and other requirements for waste shipment.

- c. Perform and document decontamination procedures prior to leaving the worksite and again before leaving the disposal site.

3.4.5 Disposal of Contaminated Soil And Water

Dispose contaminated materials removed from the site to a treatment/disposal facility permitted to accept such materials.

3.5 CLOSEOUT ACTIVITIES

3.5.1 Well Acceptance

Properly construct, install, develop, and test all wells according to the requirements of this specification so that they are suitable for the intended purpose. If installed wells are not functional or not in accordance with these specifications, the Contracting Officer will disapprove the well and direct repair or replacement, and instruct abandonment of the disapproved well in accordance with this specification.

3.5.2 Documentation Reports

Submit reports for well construction and development. Establish and maintain documentation reports for well construction and development to record the desired information and to assure compliance with contract requirements, including, but not limited to: borehole logs, well construction diagrams, geophysical logs, and well decommissioning/abandonment records.

3.5.2.1 Borehole Logs

Submit original borehole logs, within 10 working days after completion of the boring and well installation procedures. Prepare and complete a borehole log for each boring drilled, prepared by the geologist present onsite during all well drilling and installation activities. Provide the log scale at 1 inch equals 1 foot. Keep copies current and complete all well logs in the field at each well site and make available at all times for inspection by the Contracting Officer. Include, as a minimum, the following:

- a. Name of the project and site.
- b. Boring/well identification number.
- c. Location of boring (coordinates, if available).
- d. Make and manufacturer's model designation of drilling equipment and name of drilling firm.
- e. Date boring was drilled.
- f. Reference data for all depth measurements.
- g. Name of driller and name and signature of geologist preparing log.
- h. Nominal hole diameter and depth at which hole diameter changes.
- i. Total depth of boring.

- j. Method of drilling, including sampling methods and sample depths, including those attempted with no recovery. Indication of penetration resistance such as drive hammer blows given in blows per 6 inches of driven sample tubes. Include in information hammer weight and drop distance. Record information such as rod size, bit type, pump type, etc. Also include a description of any temporary casing used, drill fluids and fluid additives used, if any, including brand name and amount used, along with the reason for and start (by depth) of its use, and, if measured, mud viscosities and weight.
- k. Depth of each change of stratum. If location of strata change is approximate, so state in the report.
- l. Description of the material of which each stratum is composed, in accordance with ASTM D2488, and/or standard rock nomenclature, as necessary. Include in soil parameters for logging, but do not limit to: classification, depositional environment and formation, if known, Unified Soil Classification Symbol, secondary components and estimated percentages, color (using FSUP 77341 or GSA RCC00100R), plasticity, consistency (cohesive soil), density (non-cohesive soil), moisture content, structure and orientation, and grain angularity.
- m. Include in rock core parameters for logging, but do not limit to: rock type, formation, modifier denoting variety (shaly, calcareous, siliceous, etc.), color (using GSA RCC00100R), hardness, degree of cementation, texture, crystalline structure and orientation, degree of weathering, solution or void conditions, primary and secondary permeability, and lost core.
- n. Include the results of any chemical field screening on the boring log. Prepare classification in the field at the time of sampling. Also duly note and record the results of visual observation of the material encountered, and any unusual odor detected.
- o. Depth of any observed fractures, with strike and dip, weathered zones, or any abnormalities encountered.
- p. Depth and estimated percent of drill fluid loss or lost circulation. Measures taken to regain drill water circulation. Significant color changes in the drilling fluid return.
- q. Depth to water, and any non-aqueous phase liquids (NAPLs) and date measured before, during, and after each drilling shift, and prior to well installation. Provide and maintain at each well under construction a portable water, and NAPL level measuring device of sufficient length to measure the water/NAPL level to 100 foot depth. Make the device onsite at all times and provide graduated measuring wire in 0.01 foot. Take water and NAPL level measurements to the nearest 0.01 foot.
- r. Box or sample number. Record depths and the number of the core boxes and/or samples at the proper interval.
- s. Percent Rock Core Recovery. If rock is cored, show the percent core recovery for the individual drill runs.

3.5.2.2 Installation Diagrams

Submit as-built installation diagram for each monitoring well installed

within 10 working days of the completion of the installation, prepared by the geologist present during well installation operations. The well will not be accepted by the Contracting Officer before the geologic logs and installation diagrams are received. Clearly illustrate in the diagram the as-built condition of the well and include, but do not limit to the following items:

- a. Name of the project and site.
- b. Well identification number.
- c. Name of driller and name and signature of the geologist preparing diagram.
- d. Date of well installation.
- e. Description of material from which the well is constructed, including well casing and riser pipe and screen material, centralizer composition, if used, diameter and schedule of casing and screen, gradation of filter pack, lithologic description, brand name (if any), source, and processing method, and method of placement of the filter pack, bentonite seal type (pellets, granules, chips, or slurry), grout type (cement or high-solids bentonite) and type of protective cover (protective casing or flush-to-ground).
- f. Total depth of well.
- g. Nominal hole diameter.
- h. Depth to top and bottom of screen, and filter pack.
- i. Depth to top and bottom of any seals installed in the well boring (grout or bentonite).
- j. Type of cement and/or bentonite used, mix ratios of grout, method of placement and quantities used.
- k. Elevations/depths/heights of key features of the well, such as top of well casing and riser pipe, top and bottom of protective casing, ground surface, the depth of maximum frost penetration (frost line), bottom of well screen, top and bottom of filter pack, and top and bottom of seal.
- l. Other pertinent construction details, such as slot size and percent open area of screen, type of screen, and manufacturer of screen.
- m. Well location by coordinates. Include a plan sheet showing the coordinate system used and the location of each well. A plan sheet is not required for each well installation diagram; multiple wells may be shown on the same sheet.
- n. Static water level upon completion of the well.
- o. Special problems and their resolutions; e.g., grout in wells, lost casing, or screens, bridging, etc.
- p. Description of surface completion.

3.5.3 Well Decommissioning/Abandonment Records

Submit a well decommissioning/abandonment record, for each well, or test hole abandoned, within 10 working days of the completion of the abandonment procedure. Include in decommissioning/abandonment records, as a minimum, the following:

- a. Project name.
- b. Well or test hole number.
- c. Well/boring location, depth and diameter.
- d. Date of decommissioning/abandonment.
- e. Method of decommissioning/abandonment.
- f. All materials used in the decommissioning/abandonment procedure and the interval in which test materials were placed.
- g. Casing, and or other items left in hole by depth, description, and composition.
- h. Description and total quantity of grout used initially.
- i. Description and daily quantities of grout used to compensate for settlement.
- j. Water or mud level (specify) prior to grouting and date measured.
- k. The reason for decommissioning/abandonment of the monitoring well/test hole.

-- End of Section --

SECTION 33 71 02

UNDERGROUND ELECTRICAL DISTRIBUTION

02/15, CHG 1: 11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 306 (2010; R 2015) Standard Specification for
Drainage, Sewer, Utility, and Related
Castings

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318M (2014; ERTA 2015) Building Code
Requirements for Structural Concrete &
Commentary

ACI SP-66 (2004) ACI Detailing Manual

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS8 (2013) Specification for Extruded
Dielectric Shielded Power Cables Rated 5
Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M (2003; R 2021) Standard Specification for
Gray Iron Castings

ASTM A536 (1984; R 2019; E 2019) Standard
Specification for Ductile Iron Castings

ASTM B1 (2013) Standard Specification for
Hard-Drawn Copper Wire

ASTM B3 (2013) Standard Specification for Soft or
Annealed Copper Wire

ASTM B8 (2011; R 2017) Standard Specification for
Concentric-Lay-Stranded Copper Conductors,
Hard, Medium-Hard, or Soft

ASTM B496 (2016; R 2021) Standard Specification for
Compact Round Concentric-Lay-Stranded
Copper Conductors

ASTM C32 (2013; R 2017) Standard Specification for

Sewer and Manhole Brick (Made from Clay or Shale)

ASTM C309	(2019) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C857	(2016) Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM C990	(2009; R 2014) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM F2160	(2016) Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 48	(2020) Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE 386	(2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
IEEE 400.2	(2013) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)
IEEE 404	(2012) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
IEEE 495	(2007) Guide for Testing Faulted Circuit Indicators
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-94-649 (2013) Standard for Concentric Neutral
Cables Rated 5 Through 46 KV

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2017; Errata 2017) Standard for
Acceptance Testing Specifications for
Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1 (2016) Electric Connectors - Sealed
Insulated Underground Connector Systems
Rated 600 Volts

ANSI/NEMA WC 71/ICEA S-96-659 (2014) Standard for Nonshielded Cables
Rated 2001-5000 Volts for use in the
Distribution of Electric Energy

ANSI/NEMA WC 74/ICEA S-93-639 (2017) 5-46 kV Shielded Power Cable for
Use in the Transmission and Distribution
of Electric Energy

NEMA RN 1 (2005; R 2013) Polyvinyl-Chloride (PVC)
Externally Coated Galvanized Rigid Steel
Conduit and Intermediate Metal Conduit

NEMA TC 2 (2020) Standard for Electrical Polyvinyl
Chloride (PVC) Conduit

NEMA TC 7 (2016) Smooth-Wall Coilable Electrical
Polyethylene Conduit

NEMA TC 9 (2020) Standard for Fittings for Polyvinyl
Chloride (PVC) Plastic Utilities Duct for
Underground Installation

NEMA WC 74/ICEA S-93-639 (2012) 5-46 kV Shielded Power Cable for
Use in the Transmission and Distribution
of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

SOCIETY OF CABLE TELECOMMUNICATIONS ENGINEERS (SCTE)

ANSI/SCTE 77 (2013) Specification for Underground
Enclosure Integrity

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-758 (2012b) Customer-Owned Outside Plant
Telecommunications Infrastructure Standard

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1751F-644 (2002) Underground Plant Construction

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60005 (Basic; Notice 2) Frames, Covers,
Gratings, Steps, Sump And Catch Basin,
Manhole

UNDERWRITERS LABORATORIES (UL)

UL 6 (2007; Reprint Sep 2019) UL Standard for
Safety Electrical Rigid Metal Conduit-Steel

UL 44 (2018; Reprint May 2021) UL Standard for
Safety Thermoset-Insulated Wires and Cables

UL 83 (2017; Reprint Mar 2020) UL Standard for
Safety Thermoplastic-Insulated Wires and
Cables

UL 94 (2013; Reprint Jun 2020) UL Standard for
Safety Tests for Flammability of Plastic
Materials for Parts in Devices and
Appliances

UL 467 (2013; Reprint Jun 2017) UL Standard for
Safety Grounding and Bonding Equipment

UL 486A-486B (2018; Reprint May 2021) UL Standard for
Safety Wire Connectors

UL 510 (2020) UL Standard for Safety Polyvinyl
Chloride, Polyethylene and Rubber
Insulating Tape

UL 514A (2013; Reprint Aug 2017) UL Standard for
Safety Metallic Outlet Boxes

UL 514B (2012; Reprint May 2020) Conduit, Tubing
and Cable Fittings

UL 651 (2011; Reprint Mar 2020) UL Standard for
Safety Schedule 40, 80, Type EB and A
Rigid PVC Conduit and Fittings

UL 854 (2020) Standard for Service-Entrance Cables

UL 1072 (2006; Reprint Apr 2020) Medium-Voltage
Power Cables

UL 1242 (2006; Reprint Aug 2020) Standard for
Electrical Intermediate Metal Conduit --
Steel

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section,

with the additions and modifications specified herein.

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.
- b. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.
- c. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit modified drawings and engineering calculations associated with design changes required for use of aluminum conductors.

Precast underground structures; G

SD-03 Product Data

Medium voltage cable; G

Medium voltage cable joints; G

Medium voltage cable terminations; G

Precast concrete structures; G

Sealing Material

Pulling-In Irons

Landslide Manhole frames and covers; G

Handhole frames and covers; G

Composite/fiberglass handholes; G

Cable supports (racks, arms and insulators); G

SD-06 Test Reports

Medium voltage cable qualification and production tests; G

Field Acceptance Checks and Tests; G

Arc-proofing test for cable fireproofing tape; G

Cable Installation Plan and Procedure; G

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Separate sections by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

- a. Site layout drawing with cable pulls numerically identified.
- b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.
- c. The cable manufacturer and type of cable.
- d. The dates of cable pulls, time of day, and ambient temperature.
- e. The length of cable pull and calculated cable pulling tensions.
- f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Cable splicer/terminator; G

Cable Installer Qualifications; G

1.5 QUALITY ASSURANCE

1.5.1 Precast Underground Structures

Submittal required for each type used. Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

- a. Material description (i.e., f'c and Fy)
- b. Manufacturer's printed assembly and installation instructions
- c. Design calculations
- d. Reinforcing shop drawings in accordance with ACI SP-66
- e. Plans and elevations showing opening and pulling-in iron locations and details

1.5.2 Certificate of Competency for Cable Splicer/Terminator

The cable splicer/terminator must have a certification from the National Cable Splicing Certification Board (NCSCB) in the field of splicing and terminating shielded medium voltage (5 kV to 35 kV) power cable using pre-manufactured kits (pre-molded, heat-shrink, cold shrink). Cable splicer must be NCSCB certified for terminating medium voltage cabling with kits and for splicing medium voltage cabling with hand-applied taping.

Submit "Proof of Certification" for approval, for the individuals that will be performing cable splicer and termination work, 30 days before splices or terminations are to be made.

1.5.3 Cable Installer Qualifications

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. Provide a resume showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers. Cable installer must demonstrate experience with a minimum of three medium voltage cable installations. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for an alternate qualified cable installer.

1.5.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of IEEE C2 and NFPA 70 unless more stringent requirements are specified or indicated.

1.5.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable, unless specified otherwise.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Rigid Metal Conduit

UL 6.

2.1.1.1 Rigid Metallic Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness must be nominal 85 Shore A durometer, dielectric strength must be minimum 400 volts per mil at 60 Hz, and tensile strength must be minimum 3500 psi.

2.1.1.2 Intermediate Metal Conduit

UL 1242.

2.1.2.1 Intermediate Metal Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness must be nominal 85 Shore A durometer, dielectric strength must be minimum 400 volts per mil at 60 Hz, and tensile strength must be minimum 3500 psi.

2.1.3 Plastic Conduit for Direct Burial and Riser Applications

UL 651 and NEMA TC 2, EPC-40 and EPC-80.

2.1.4 Plastic Duct for Concrete Encasement

Provide Type EPC-40 per UL 651 and NEMA TC 2.

2.1.5 High Density Polyethylene (HDPE) Electrical Conduit for Directional Boring

Smoothwall, approved/listed for directional boring, minimum Schedule 80, ASTM F2160, NEMA TC 7.

2.1.6 Innerduct

Provide corrugated polyethylene (PE) or PVC innerducts, or fabric-mesh innerducts, with pullwire. Size as indicated.

2.1.7 Duct Sealant

UL 94, Class HBF. Provide high-expansion urethane foam duct sealant that expands and hardens to form a closed, chemically and water resistant, rigid structure. Sealant must be compatible with common cable and wire jackets and capable of adhering to metals, plastics and concrete. Sealant must be capable of curing in temperature ranges of 35 degrees F to 95 degrees F. Cured sealant must withstand temperature ranges of -20 degrees F to 200 degrees F without loss of function.

2.1.8 Fittings

2.1.8.1 Metal Fittings

UL 514B.

2.1.8.2 PVC Conduit Fittings

UL 514B, UL 651.

2.1.8.3 PVC Duct Fittings

NEMA TC 9.

2.1.8.4 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit must be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and must conform to UL 514A.

2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors must be rated 600 volts and conform to the requirements of NFPA 70, including listing requirements. Wires and cables manufactured more than 24 months prior to date of delivery to the site are not acceptable. Service entrance conductors must conform to UL 854, type USE.

2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and THHN/THWN unless otherwise noted. Conductors No. 10 AWG and smaller must be solid. Conductors No. 8 AWG and larger must be stranded. Conductors No. 6 AWG and smaller must be copper. All conductors must be copper.

2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, must be 600-volt, Type THWN/THHN conforming to UL 83 or Type RHW conforming to UL 44. Copper conductors must be annealed copper complying with ASTM B3 and ASTM B8.

2.2.3 Jackets

Multiconductor cables must have an overall PVC outer jacket.

2.2.4 In Duct

Cables must be single-conductor cable.

2.2.5 Cable Marking

Insulated conductors must have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Identify each cable by means of a fiber, laminated plastic, or non-ferrous metal tags in each manhole, handhole, junction box, and each terminal. Each tag must contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

Conductors must be color coded. Provide conductor identification within each enclosure where a tap, splice, or termination is made. Conductor identification must be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, heat shrink type sleeves, or colored electrical tape. Control circuit terminations must be properly identified. Color must be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals must be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems must be as follows:

- a. 208/120 volt, three-phase
 - (1) Phase A - black
 - (2) Phase B - red
 - (3) Phase C - blue
- b. 480/277 volt, three-phase
 - (1) Phase A - brown
 - (2) Phase B - orange
 - (3) Phase C - yellow

2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

Must provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.

- a. For use with copper conductors: UL 486A-486B.

2.4 LOW VOLTAGE SPLICES

Provide splices in conductors with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply with ANSI C119.1.

2.4.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material applied in accordance with the manufacturer's written instructions.

2.4.2 Cold Shrink Rubber Splice

Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation must not require heat or flame, or any additional materials such as covering or adhesive. It must be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.5 MEDIUM VOLTAGE CABLE

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors must have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 24 months prior to date of delivery to the site are not acceptable. Provide single conductor type cables unless otherwise indicated.

2.5.1 Cable Configuration

Provide Type MV cable, conforming to NEMA WC 74/ICEA S-93-639 and UL 1072.

Provide cables manufactured for use in duct or direct burial applications as indicated. Cable must be rated 15 kV with 133 percent insulation level.

2.5.2 Conductor Material

Provide concentric-lay-stranded, Class B compact round conductors. Provide soft drawn copper cables complying with ASTM B3 and ASTM B8 for regular concentric and compressed stranding or ASTM B496 for compact stranding.

2.5.3 Insulation

Provide ethylene-propylene-rubber (EPR) insulation conforming to the requirements of ANSI/NEMA WC 71/ICEA S-96-659, ANSI/NEMA WC 74/ICEA S-93-639 and AEIC CS8/ICEA S-94-649.

2.5.4 Shielding

Cables rated for 2 kV and above must have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape shield for each phase.

2.5.5 Neutrals

Neutral conductors must be copper, employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable. Concentric neutrals conductors must be copper, having a combined ampacity equal to 1/3 of the phase conductor ampacity rating.

2.5.6 Jackets

Provide cables with a PVC jacket. Direct buried cables must be rated for direct burial.

2.6 MEDIUM VOLTAGE CABLE TERMINATIONS

IEEE 48 Class 1; of the molded elastomer, prestretched elastomer, or heat-shrinkable elastomer. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations, where required, must be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, or armor. Terminations must be provided in a kit, including: skirts, stress control terminator, ground clamp, connectors, lugs, and complete instructions for assembly and installation. Terminations must be the product of one manufacturer, suitable for the type, diameter, insulation class and level, and materials of the cable terminated. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.

2.6.1 Hand-Applied Tape Splicing

Termination must not require heat or flame for installation. Termination kit must contain all necessary materials (except for the lugs). Termination must be designed for installation in low or highly

contaminated indoor and outdoor locations and must resist ultraviolet rays and oxidative decomposition.

2.6.2 Cold-Shrink Type

Terminator must be a one-piece design, utilizing the manufacturer's latest technology, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber.

Termination must not require heat or flame for installation. Termination kit must contain all necessary materials (except for the lugs).

Termination must be designed for installation in low or highly contaminated indoor and outdoor locations and must resist ultraviolet rays and oxidative decomposition.

2.6.3 Heat Shrinkable Type

Terminator must consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking, resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition. Provide heat shrinkable sheds or skirts of the same material. Termination must be designed for installation in low or highly contaminated indoor or outdoor locations.

2.6.4 Separable Insulated Connector Type

IEEE 386. Provide connector with steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material. Provide connectors of the loadbreak or deadbreak type as indicated, of suitable construction for the application and the type of cable connected, and that include cable shield adaptors. Provide external clamping points and test points. Separable connectors must not be used in manholes/handholes.

- a. 600 Ampere deadbreak connector ratings: Voltage: 15 kV, 95 kV BIL. Short time rating: 25,000 rms symmetrical amperes. Connectors must have 200 ampere bushing interface.
- b. Install one set of faulted circuit indicators on the test points of each set of separable insulated connectors. Faulted circuit indicators must comply with IEEE 495. Indicators must be self powered; with automatic trip with mechanical flag indication upon overcurrent followed by loss of system voltage, and automatic reset upon restoration of system voltage. Indicators must be compact, sealed corrosion resistant construction with provision for hotstick installation and operation.

2.7 MEDIUM VOLTAGE CABLE JOINTS

Provide joints (splices) in accordance with IEEE 404 suitable for the rated voltage, insulation level, insulation type, and construction of the cable. Joints must be certified by the manufacturer for waterproof, submersible applications. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint must be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion.

2.8 TELECOMMUNICATIONS CABLING

Provide telecommunications cabling in accordance with Section 33 82 00

TELECOMMUNICATIONS OUTSIDE PLANT (OSP).

2.9 TAPE

2.9.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.9.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

2.9.3 Fireproofing Tape

Provide tape composed of a flexible, conformable, unsupported intumescent elastomer. Tape must be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, adhesive-free, and must not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.10 PULL ROPE

Plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Provide copper-clad steel ground rods conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

2.11.2 Grounding Conductors

Stranded-bare copper conductors must conform to ASTM B8, Class B, soft-drawn unless otherwise indicated. Solid-bare copper conductors must conform to ASTM B1 for sizes No. 8 and smaller. Insulated conductors must be of the same material as phase conductors and green color-coded, except that conductors must be rated no more than 600 volts. Aluminum is not acceptable.

2.12 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. In addition, provide concrete for encasement of underground ducts with 3000 psi minimum 28-day compressive strength. Concrete associated with electrical work for other than encasement of underground ducts must be 4000 psi minimum 28-day compressive strength unless specified otherwise.

2.13 UNDERGROUND STRUCTURES

Provide precast concrete underground structures or standard type cast-in-place manhole types as indicated, conforming to ASTM C857 and ASTM C478. Top, walls, and bottom must consist of reinforced concrete. Walls and bottom must be of monolithic concrete construction. Locate duct

entrances and windows near the corners of structures to facilitate cable racking. Covers must fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings must be free from warp and blow holes that may impair strength or appearance. Exposed metal must have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, must be adequate to accommodate the cable.

2.13.1 Cast-In-Place Concrete Structures

Concrete must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.13.2 Precast Concrete Structures, Risers and Tops

Precast concrete underground structures may be provided in lieu of cast-in-place subject to the requirements specified below. Precast units must be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes.

2.13.2.1 General

Precast concrete structures must have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures must have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction must be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work must have a 28-day compressive strength of not less than 4000 psi. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures must be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

2.13.2.2 Design for Precast Structures

ACI 318M. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

- a. Angle of Internal Friction (ϕ) = 30 degrees
- b. Unit Weight of Soil (Dry) = 110 pcf, (Saturated)
= 130 pcf
- c. Coefficient of Lateral Earth Pressure (K_a) = 0.33
- d. Ground Water Level = 3 feet below ground elevation
- e. Vertical design loads must include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads must consider all types and magnitudes of vehicular (automotive, industrial) traffic to be encountered.
- f. Horizontal design loads must include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of

installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, must be considered, along with a pulling-in iron design load of 6000 pounds.

- g. Each structural component must be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.
- h. Design must also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

2.13.2.3 Construction

Structure top, bottom, and wall must be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances are not permitted. Provide quantity, size, and location of duct bank entrance windows as directed, and cast completely open by the precaster. Size of windows must exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows must be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. Provide drain sumps a minimum of 12 inches in diameter and 4 inches deep for precast structures.

2.13.2.4 Joints

Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to ASTM C990. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.13.3 Landslide Manhole Frames and Covers

Provide airport rated ASTM A48/A48M cast iron frames and ASTM A536 ductile iron covers for manholes conforming to CID A-A-60005. Cast the words "ELECTRIC" or "TELECOMMUNICATIONS" in the top face of power and telecommunications manhole covers, respectively. A machine-finished seat shall be provided to ensure a level fit between frames and covers. Size and shape of covers shall be as indicated. Design to withstand a 100,000 pound load applied on a 9 inch by 9 inch square area. Perform proof loading in accordance with AASHTO M 306. Proof loads must be physically stamped into the cover. Submit certification on the ability of frame and cover or gratings to carry the imposed live load.

2.13.4 Landslide Telecommunications Handhole Frames and Covers

Provide airport rated ASTM A48/A48M cast iron frames and ASTM A536 ductile iron covers for manholes conforming to CID A-A-60005. Cast the words "TELECOMMUNICATIONS" in the top face of telecommunications manhole covers, respectively. A machine-finished seat shall be provided to ensure a level fit between frames and covers. Size and shape of covers shall be as indicated. Design to withstand a 100,000 pound load applied on a 9 inch by 9 inch square area. Perform proof loading in accordance with AASHTO M 306. Proof loads must be physically stamped into the cover. Submit certification on the ability of frame and cover or gratings to carry the imposed live load.

2.13.5 Pier and Trestle Vault Frames and Covers

Provide indicated steel vault covers for the pier and trestle vault. Provide label for the cover stating the words "ELEC" or "COMM" in the top face of power and telecommunications vault covers, respectively. A machine-finished seat shall be provided to ensure a level fit between frames and covers. Size and shape of covers shall be as indicated. Perform proof loading in accordance with AASHTO M 306. Proof loads must be physically stamped into the cover. Submit certification on the ability of frame and cover or gratings to carry the imposed live load.

2.13.6 Handhole Frames and Covers

Frames and covers of steel must be welded by qualified welders in accordance with standard commercial practice. Steel covers must be rolled-steel floor plate having an approved antislip surface. Hinges must be of stainless steel with bronze hinge pin, 5 by 5 inches by approximately 3/16 inch thick, without screw holes, and must be for full surface application by fillet welding. Hinges must have nonremovable pins and five knuckles. The surfaces of plates under hinges must be true after the removal of raised antislip surface, by grinding or other approved method.

2.13.7 Brick for Manhole Collar

Provide sewer and manhole brick conforming to ASTM C32, Grade MS.

2.13.8 Composite/Fiberglass Handholes and Covers

ANSI/SCTE 77. Provide handholes and covers of polymer concrete, reinforced with heavy weave fiberglass with a design load (Tier rating) appropriate for or greater than the intended use. All covers are required to have the Tier level rating embossed on the surface and this rating must not exceed the design load of the box.

2.14 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

The metal portion of racks and arms must be zinc-coated after fabrication.

2.14.1 Cable Rack Stanchions

The wall bracket or stanchion must be 4 inches by approximately 1-1/2 inch by 3/16 inch channel steel, or 4 inches by approximately 1 inch glass-reinforced nylon with recessed bolt mounting holes, 48 inches long (minimum) in manholes. Slots for mounting cable rack arms must be spaced at 8 inch intervals.

2.14.2 Rack Arms

Cable rack arms must be glass reinforced nylon and must be of the removable type. Rack arm length must be a minimum of 8 inches and a maximum of 12 inches.

2.15 CABLE TAGS IN MANHOLES

Provide tags for each power cable located in manholes. The tags must be polyethylene. Do not provide handwritten letters. The first position on the power cable tag must denote the voltage. The second through sixth positions on the tag must identify the circuit. The next to last position must denote the phase of the circuit and include the Greek "phi" symbol. The last position must denote the cable size. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

2.15.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties must have a minimum loop tensile strength of 175 pounds. The cable tags must have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols must not fall off or change positions regardless of the cable tags' orientation.

2.16 SOURCE QUALITY CONTROL

2.16.1 Arc-Proofing Test for Cable Fireproofing Tape

Manufacturer must test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2 inch outside diameter, and a 1/8 inch thick wall, and covered with one-half lap layer of arc and fireproofing tape per manufacturer's instructions. The arc and fireproofing tape must withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode must be obtained from a dc power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc must be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly must be tested at three unrelated points. Start time for tests must be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time must be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape must indicate that the test has been performed and passed by the manufacturer.

2.16.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS8 qualification and production tests as applicable for

each type of medium voltage cable.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable. In addition to these requirements, install telecommunications in accordance with TIA-758 and RUS Bull 1751F-644.

3.2 CABLE INSPECTION

Inspect each cable reel for correct storage positions, signs of physical damage, and broken end seals prior to installation. If end seal is broken, remove moisture from cable prior to installation in accordance with the cable manufacturer's recommendations.

3.3 CABLE INSTALLATION PLAN AND PROCEDURE

Obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature limits for installation, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. Perform pulling calculations and prepare a pulling plan and submit along with the manufacturer's instructions in accordance with SUBMITTALS. Install cable strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.

Calculations and pulling plan must include:

- a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.
- b. List of cable installation equipment.
- c. Lubricant manufacturer's application instructions.
- d. Procedure for resealing cable ends to prevent moisture from entering cable.
- e. Cable pulling tension calculations of all cable pulls.
- f. Cable percentage conduit fill.
- g. Cable sidewall bearing pressure.
- h. Cable minimum bend radius and minimum diameter of pulling wheels used.
- i. Cable jam ratio.
- j. Maximum allowable pulling tension on each different type and size of conductor.
- k. Maximum allowable pulling tension on pulling device.

3.4 UNDERGROUND FEEDERS SUPPLYING BUILDINGS

Terminate underground feeders supplying building at terminating point indicated. Coordinate connections of the feeders to the service entrance equipment with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide conduit as indicated from the supply equipment to the building and projections thereof. Protect ends of underground conduit with plastic plugs until connections are made.

3.5 UNDERGROUND STRUCTURE CONSTRUCTION

Provide standard type cast-in-place construction as specified herein and as indicated, or precast construction as specified herein. Horizontal concrete surfaces of floors must have a smooth trowel finish. Cure concrete by applying two coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound must conform to ASTM C309. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground structures must fit the frames without undue play. Steel and iron must be formed to shape and size with sharp lines and angles. Castings must be free from warp and blow holes that may impair strength or appearance. Exposed metal must have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Manhole locations, as indicated, are approximate. Coordinate exact manhole locations with other utilities and finished grading and paving.

3.5.1 Cast-In-Place Concrete Structures

Concrete must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE. Concrete block is not allowed.

3.5.2 Precast Concrete Construction

Set commercial precast structures on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to 1 inch size, extending 12 inches beyond the structure on each side. Compact granular fill by a minimum of four passes with a plate type vibrator. Installation must additionally conform to the manufacturer's instructions.

3.5.3 Pulling-In Irons

Provide steel bars bent as indicated, and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices must be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons must be a minimum of 6 inches from the edge of the sump, and in the walls the irons must be located within 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron must not be located within 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast

window the minimum distance required to preserve the 6 inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 3 foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner must be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons must have a clear projection into the structure of approximately 4 inches and must be designed to withstand a minimum pulling-in load of 6000 pounds. Irons must be hot-dipped galvanized after fabrication.

3.5.4 Cable Racks, Arms and Insulators

Cable racks, arms and insulators must be sufficient to accommodate the cables. Space racks in power manholes not more than 3 feet apart, and provide each manhole wall with a minimum of two racks. Space racks in signal manholes not more than 16 1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. Methods of anchoring cable racks must be as follows:

- a. Provide a 5/8 inch diameter by 5 inch long anchor bolt with 3 inch foot cast in structure wall with 2 inch protrusion of threaded portion of bolt into structure. Provide 5/8 inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with suitable coating immediately prior to installing nuts.
- b. Provide concrete channel insert with a minimum load rating of 800 pounds per foot. Insert channel must be steel of the same length as "vertical rack channel;" channel insert must be cast flush in structure wall. Provide 5/8 inch steel nuts in channel insert to receive 5/8 inch diameter by 3 inch long steel, square head anchor bolts.
- c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert must have minimum 800 pound load rating. Provide 5/8 inch diameter by 3 inch long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with suitable coating immediately prior to installing bolts.

3.5.5 Field Painting

Cast-iron frames and covers not buried in concrete or masonry must be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.

3.6 DIRECT BURIAL CABLE SYSTEM

Cables must be buried directly in the earth below the frostline as indicated.

3.6.1 Trenching

Excavate trenches for direct-burial cables to provide a minimum cable cover of 24 inches below finished grade for power conductors operated at 600 volts or less, and 30 inches below finished grade for over 600 volts in accordance with IEEE C2. When rock is encountered, remove to a depth

of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch. Bottoms of trenches must be smooth and free of stones and sharp objects. Where materials in bottoms of trenches are other than sand, a 75 mm 3 inch layer of sand must be laid first and compacted to approximate densities of surrounding firm soil. Trenches must be not less than 8 inches wide, and must be in straight lines between cable markers. Bends in trenches must have a radius of not less than 36 inches.

3.6.2 Cable Installation

Unreel cables along the sides of or in trenches and carefully place on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position is not permitted, except as required to pull cables through conduits under paving or railroad tracks.

Where two or more cables are laid parallel in the same trench, space cables laterally at not less than 3 inches apart, except that communication cable must be separated from power cable by a minimum distance of 12 inches.

Where direct-burial cables cross under roads or other paving exceeding 5 feet in width, such cables must be installed in concrete-encased ducts. Ducts must extend at least 5 feet beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables must be centered in duct entrances, and a waterproof nonhardening mastic compound must be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Prevent damage to conduit coatings by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase must be restored to their original condition. Where cable is placed in duct(e.g. under paved areas, roads, or railroads), slope ducts to drain.

3.6.3 Splicing

Provide cables in one piece without splices between connections except where the distance exceeds the lengths in which cables are manufactured. Where splices are required, install splices only in maintenance manholes/handholes or cabinets/pedestals.

3.6.4 Bends

Bends in cables must have an inner radius not less than those specified in NFPA 70 for the type of cable, or manufacturer's recommendation.

3.6.5 Horizontal Slack

Leave approximately 3 feet of horizontal slack in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought above ground. Where cable is brought above ground, leave additional slack to make necessary connections. Enclose splices in lead-sheathed or armored cables in split-type cast-iron splice boxes; after completion of the connection, fill with insulating filler compound and tightly clamp the box.

3.6.6 Identification Slabs or Markers

Provide a slab at each change of direction of cable, over the ends of ducts or conduits which are installed under paved areas and roadways, over the ends of ducts or conduits stubbed out for future use, and over each splice. Identification slabs must be of concrete, approximately 20 inches square by 6 inches thick and must be set flat in the ground so that top surface projects not less than 3/4 inch, nor more than 1 1/4 inches above ground. Concrete must have a compressive strength of not less than 3000 psi and have a smooth troweled finish on exposed surface. Inscribe an identifying legend such as "electric cable," "telephone cable," "splice," or other applicable designation on the top surface of the slab before concrete hardens. Inscribe circuit identification symbols on slabs as indicated. Letters or figures must be approximately 2 inches high and grooves must be approximately 1/4 inch in width and depth. Install slabs so that the side nearest the inscription on top must include an arrow indicating the side nearest the cable. Provide color, type and depth of warning tape as specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

3.7 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.7.1 Requirements

Run conduit in straight lines except where a change of direction is necessary. Provide numbers and sizes of ducts as indicated. Provide a 4/0 AWG bare copper grounding conductor parallel to medium-voltage distribution duct banks. Bond bare copper grounding conductor to ground rings (loops) in all manholes and to ground rings (loops) at all equipment slabs (pads). Route grounding conductor into manholes with the duct bank (sleeving is not required). Ducts must have a continuous slope downward toward underground structures and away from buildings, laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Provide ducts with end bells whenever duct lines terminate in structures.

Perform changes in ductbank direction as follows:

- a. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable.
- b. The minimum manufactured bend radius must be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter.
- c. As an exception to the bend radius required above, provide field manufactured longsweep bends having a minimum radius of 25 feet for a change of direction of more than 5 degrees, either horizontally or vertically, using a combination of curved and straight sections. Maximum manufactured curved sections: 30 degrees.

3.7.2 Treatment

Ducts must be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers must be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer must be used whenever an existing duct is connected to a duct of different material or shape. Ducts must be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water

or solid substances. Ducts must be thoroughly cleaned before being laid. Plastic ducts must be stored on a flat surface and protected from the direct rays of the sun.

3.7.3 Conduit Cleaning

As each conduit run is completed, for conduit sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs.

3.7.4 Galvanized Conduit Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations must be PVC coated and must extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.7.5 Multiple Conduits

Separate multiple conduits by a minimum distance of 3 inches, except that light and power conduits must be separated from control, signal, and telephone conduits by a minimum distance of 12 inches. Stagger the joints of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly must consist of base spacers, intermediate spacers, ties, and locking device on top to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.7.6 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty must be provided with plugs on each end. Plugs must contain a weephole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.7.7 Conduit and Duct Without Concrete Encasement

3.7.7.1 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. Concrete encasement must extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks. Depths to top of the concrete envelope must be not less than 24 inches below finished grade.

3.7.8 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Depths to top of the concrete envelope must be not less than 18 inches below finished grade, except under roads and pavement, concrete envelope must be not less than 24 inches below finished grade. Do not mix

different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank must be rectangular in cross-section and must provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 3 inches. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring must be done by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly. Provide steel reinforcing in the concrete envelope as indicated.

Provide color, type and depth of warning tape as specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

3.7.8.1 Connections to Manholes

Duct bank envelopes connecting to underground structures must be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section must be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. Perimeter of the duct bank opening in the underground structure must be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

3.7.8.2 Connections to Existing Underground Structures

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and bend out to tie into the reinforcing of the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.7.8.3 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, and, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately one foot apart. Restrain reinforcing assembly from moving during concrete pouring.

3.7.9 Duct Sealing

Seal all electrical penetrations for radon mitigation, maintaining integrity of the vapor barrier, and to prevent infiltration of air, insects, and vermin.

3.8 CABLE PULLING

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with

tape shield must have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.8.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.9 CABLES IN UNDERGROUND STRUCTURES

Do not install cables utilizing the shortest path between penetrations, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

3.9.1 Cable Tag Installation

Install cable tags in each manhole as specified, including each splice. Tag wire and cable provided by this contract. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes.

3.10 CONDUCTORS INSTALLED IN PARALLEL

Conductors must be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor.

3.11 LOW VOLTAGE CABLE SPLICING AND TERMINATING

Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set. Make splices in underground distribution systems only in accessible locations such as manholes, handholes, or aboveground termination pedestals.

3.12 MEDIUM VOLTAGE CABLE TERMINATIONS

Make terminations in accordance with the written instruction of the termination kit manufacturer.

3.13 MEDIUM VOLTAGE CABLE JOINTS

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods in accordance with the written instructions of the joint kit manufacturer.

3.13.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice. Provide a bare copper ground connection brought out in a watertight manner and grounded to the manhole grounding loop as part of the splice installation. Ground conductors, connections, and rods must be as specified elsewhere in this section. Wire must be trained to the sides of the enclosure to prevent interference with the working area.

3.14 CABLE END CAPS

Cable ends must be sealed at all times with coated heat shrinkable end caps. Cables ends must be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps must remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.15 FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in underground structures.

3.15.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.15.2 Tape-Wrap

Tape-wrap metallic-sheathed or metallic armored cables without a nonmetallic protective covering over the sheath or armor prior to application of fireproofing. Wrap must be in the form of two tightly applied half-lapped layers of a pressure-sensitive 10 mil thick plastic tape, and must extend not less than one inch into the duct. Even out irregularities of the cable, such as at splices, with insulation putty before applying tape.

3.16 GROUNDING SYSTEMS

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 5 ohms.

3.16.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 6 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded. If the specified ground resistance is not met, an additional ground rod must be provided in accordance with the requirements of NFPA 70 (placed not less than 6 feet from the first rod). Should the resultant (combined) resistance exceed the specified resistance, measured not less than 48 hours after rainfall, notify the Contracting Officer immediately.

3.16.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

- a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.
- b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies must be as recommended by the manufacturer. An embossing die code or other standard method must provide visible indication that a connector has been adequately compressed on the ground wire.

3.16.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with No. 6 AWG. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Provide direct connections to the grounding conductor with 600 v insulated, full-size conductor for each grounded neutral of each feeder circuit, which is spliced within the manhole.

3.16.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.16.5 Manhole Grounding

Loop a 4/0 AWG grounding conductor around the interior perimeter, approximately 12 inches above finished floor. Secure the conductor to the manhole walls at intervals not exceeding 36 inches. Connect the conductor to the manhole grounding electrode with 4/0 AWG conductor. Connect all incoming 4/0 grounding conductors to the ground loop adjacent to the point of entry into the manhole. Bond the ground loop to all cable shields, metal cable racks, and other metal equipment with a minimum 6 AWG conductor.

3.16.6 Fence Grounding

Provide grounding for fences as indicated. Drive ground rods until the top is 12 inches below grade. Attach a No. 4 AWG copper conductor, by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 12 inches of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence. Each gate section must be bonded to its gatepost by a 1/8 by one inch flexible braided copper strap and ground post clamps. Clamps must be of the anti-electrolysis type.

3.17 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 23 00.00 20 EXCAVATION AND FILL.

3.17.1 Reconditioning of Surfaces

3.17.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct or direct burial cable. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Provide work in accordance with Section 32 92 19 SEEDING.

3.17.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.18 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.18.1 Concrete Slabs (Pads) for Equipment

Unless otherwise indicated, the slab must be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Slab must be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab must be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade must have 1/2 inch chamfer. Slab must be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.18.2 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals must be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.19 FIELD QUALITY CONTROL

3.19.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests,

performed in accordance with NETA ATS.

3.19.1.1 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

- (1) Inspect exposed cable sections for physical damage.
- (2) Verify that cable is supplied and connected in accordance with contract plans and specifications.
- (3) Inspect for proper shield grounding, cable support, and cable termination.
- (4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius.
- (5) Inspect for proper fireproofing.
- (6) Visually inspect jacket and insulation condition.
- (7) Inspect for proper phase identification and arrangement.

b. Electrical Tests

- (1) Perform a shield continuity test on each power cable by ohmmeter method. Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.
- (2) Perform acceptance test on new cables before the new cables are connected to existing cables and placed into service, including terminations and joints. Perform maintenance test on complete cable system after the new cables are connected to existing cables and placed into service, including existing cable, terminations, and joints. Tests must be very low frequency (VLF) alternating voltage withstand tests in accordance with IEEE 400.2. VLF test frequency must be 0.05 Hz minimum for a duration of 60 minutes using a sinusoidal waveform. Test voltages must be as follows:

CABLE RATING AC TEST VOLTAGE for ACCEPTANCE TESTING	
5 kV	10kV rms(peak)
8 kV	13kV rms(peak)
15 kV	20kV rms(peak)
25 kV	31kV rms(peak)
35 kV	44kV rms(peak)

CABLE RATING AC TEST VOLTAGE for MAINTENANCE TESTING	
5 kV	7kV rms(peak)
8 kV	10kV rms(peak)
15 kV	16kV rms(peak)
25 kV	23kV rms(peak)
35 kV	33kV rms(peak)

3.19.1.2 Low Voltage Cables, 600-Volt

Perform tests after installation of cable, splices and terminations and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

- (1) Inspect exposed cable sections for physical damage.
- (2) Verify that cable is supplied and connected in accordance with contract plans and specifications.
- (3) Verify tightness of accessible bolted electrical connections.
- (4) Inspect compression-applied connectors for correct cable match and indentation.
- (5) Visually inspect jacket and insulation condition.
- (6) Inspect for proper phase identification and arrangement.

b. Electrical Tests

- (1) Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 1000 volts dc for one minute.
- (2) Perform continuity tests to insure correct cable connection.

3.19.1.3 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground

resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument must be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test. Provide site diagram indicating location of test probes with associated distances, and provide a plot of resistance vs. distance.

3.19.2 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer must be given 5 working days advance notice of the dates and times of checking and testing.

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SECTION 33 82 00

TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

- | | |
|------------|--|
| ASTM B1 | (2013) Standard Specification for
Hard-Drawn Copper Wire |
| ASTM B8 | (2011; R 2017) Standard Specification for
Concentric-Lay-Stranded Copper Conductors,
Hard, Medium-Hard, or Soft |
| ASTM D1557 | (2012; E 2015) Standard Test Methods for
Laboratory Compaction Characteristics of
Soil Using Modified Effort (56,000
ft-lbf/ft ³) (2700 kN-m/m ³) |
| ASTM D709 | (2017) Standard Specification for
Laminated Thermosetting Materials |

ICC EVALUATION SERVICE, INC. (ICC-ES)

- | | |
|--------------|---|
| ICC ES AC156 | (2012) Acceptable Criteria for Seismic
Certification by Shake-Table Testing of
Nonstructural Components |
|--------------|---|

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- | | |
|----------|--|
| IEEE 100 | (2000; Archived) The Authoritative
Dictionary of IEEE Standards Terms |
| IEEE C2 | (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code |

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

- | | |
|---------------|---|
| ICEA S-87-640 | (2016) Optical Fiber Outside Plant
Communications Cable; 4th Edition |
| ICEA S-98-688 | (2012) Broadband Twisted Pair
Telecommunication Cable, Aircore,
Polyolefin Insulated, Copper Conductors
Technical Requirements |
| ICEA S-99-689 | (2012) Broadband Twisted Pair
Telecommunication Cable Filled, Polyolefin
Insulated, Copper Conductors Technical
Requirements |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-107 (1999a) FOTP-107 Determination of Component Reflectance or Link/System Return Loss using a Loss Test Set

TIA-455-46A (1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers

TIA-455-78-B (2002) FOTP-78 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures - Attenuation

TIA-472D000 (2007b) Fiber Optic Communications Cable for Outside Plant Use

TIA-492E000 (1996; R 2002) Sectional Specification for Class IVd Nonzero-Dispersion Single-Mode Optical Fibers for the 1550 nm Window

TIA-526-14 (2015c) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

TIA-526-7 (2015a) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

TIA-568-C.1 (2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard

TIA-568-C.2 (2009; Errata 2010; Add 2 2014; Add 1 2016) Balanced Twisted-Pair Telecommunications Cabling and Components Standards

TIA-568-C.3 (2008; Add 1 2011) Optical Fiber Cabling Components Standard

TIA-569 (2015d) Commercial Building Standard for Telecommunications Pathways and Spaces

TIA-590 (1997a) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant

TIA-606	(2017c) Administration Standard for the Telecommunications Infrastructure
TIA-607	(2015c; Addendum 1 2017) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA-758	(2012b) Customer-Owned Outside Plant Telecommunications Infrastructure Standard
TIA/EIA-455	(1998b) Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components
TIA/EIA-598	(2014D; Add 2 2018) Optical Fiber Cable Color Coding

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 1755	Telecommunications Standards and Specifications for Materials, Equipment and Construction
RUS Bull 1751F-630	(1996) Design of Aerial Plant
RUS Bull 1751F-643	(2002) Underground Plant Design
RUS Bull 1751F-815	(1979) Electrical Protection of Outside Plant
RUS Bull 1753F-201	(1997) Acceptance Tests of Telecommunications Plant (PC-4)
RUS Bull 1753F-401	(1995) Splicing Copper and Fiber Optic Cables (PC-2)
RUS Bull 345-65	(1985) Shield Bonding Connectors (PE-65)

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-02	(2020) Design of Risk Category V Structures, National Strategic Military Assets
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UNDERWRITERS LABORATORIES (UL)

UL 497	(2001; Reprint Jul 2013) Protectors for Paired Conductor Communication Circuits
UL 510	(2020) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 83	(2017; Reprint Mar 2020) UL Standard for Safety Thermoplastic-Insulated Wires and Cables

1.2 RELATED REQUIREMENTS

Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM, 1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-569, TIA-606, and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates.
(International expression for main cross-connect - (MC).)

1.3.2 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

1.3.3 Entrance Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.4 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect - (IC).)

1.3.5 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The telecommunications outside plant consists of cable, conduit, manholes, poles, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, interconnecting hardware, terminating cables, lightning and surge protection modules at the entrance facility. The work consists of providing, testing and making operational cabling, interconnecting hardware and lightning and surge protection necessary to form a complete outside plant telecommunications system for continuous use.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications Outside Plant; G

Telecommunications Entrance Facility Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

Outdoor telecommunications enclosures; G

SD-03 Product Data

Wire and cable; G

Cable splices, and connectors; G

Closures; G

Building protector assemblies; G

Protector modules; G

Outdoor telecommunications enclosures; G

Outdoor telecommunications cabinet; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required for certificates in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Pre-installation tests; G

Acceptance tests; G

Outside Plant Test Plan; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Minimum Manufacturer's Qualifications; G

SD-08 Manufacturer's Instructions

Building protector assembly installation; G

Cable tensions; G

Fiber Optic Splices; G[, [____]]

Submit instructions prior to installation.

SD-09 Manufacturer's Field Reports

Factory Reel Test Data; G

SD-10 Operation and Maintenance Data

Telecommunications outside plant (OSP), Data Package 5; G

Commercial off-the-shelf manuals shall be provided for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications outside plant (OSP). Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS OUTSIDE PLANT SHOP DRAWINGS and TELECOMMUNICATIONS ENTRANCE FACILITY DRAWINGS.

SD-11 Closeout Submittals

Record Documentation; G

In addition to other requirements, provide in accordance with paragraph RECORD DOCUMENTATION.

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Outside Plant Shop Drawings

Provide Outside Plant Design in accordance with TIA-758, RUS Bull 1751F-630 for aerial system design, and RUS Bull 1751F-643 for underground system design. Provide T0 shop drawings that show the physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus backbone cabling on plan view drawings, major system nodes, and related connections on the logical system drawings in accordance with TIA-606. Drawings shall include wiring and schematic diagrams for fiber optic and copper cabling and splices, copper conductor gauge and pair count, fiber pair count and type, pathway duct and innerduct arrangement, associated construction materials, and any details required to demonstrate that cable system has been coordinated and will properly support the switching and transmission system identified in specification and drawings. Provide Registered Communications Distribution Designer (RCDD) approved drawings of the telecommunications outside plant. Update existing telecommunication Outside Plant T0

drawings to include information modified, deleted or added as a result of this installation in accordance with TIA-606. The telecommunications outside plant (OSP) shop drawings shall be included in the operation and maintenance manuals.

1.6.1.2 Telecommunications Entrance Facility Drawings

Provide T3 drawings for EF Telecommunications as specified in the paragraph TELECOMMUNICATIONS SPACE DRAWINGS of Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS. The telecommunications entrance facility shop drawings shall be included in the operation and maintenance manuals.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, the supervisor (if different from the installer), and the cable splicing and terminating personnel. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor Qualifications

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems that include outside plant and broadband cabling within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems in accordance with TIA-758 within the past 3 years.

1.6.2.2 Key Personnel Qualifications

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Cable splicing and terminating personnel assigned to the installation of this system or any of its components shall have training in the proper techniques and have a minimum of 3 years experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

Supervisors and installers assigned to the installation of this system or any of its components shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications outside plant systems, including broadband cabling, and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum Manufacturer's Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with, TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3. In addition, cabling manufacturers shall have a minimum of 3 years experience in the manufacturing and factory testing of cabling which comply with ICEA S-87-640, ICEA S-98-688, and ICEA S-99-689.

1.6.3 Outside Plant Test Plan

Prepare and provide a complete and detailed test plan for field tests of the outside plant including a complete list of test equipment for the copper conductor and optical fiber cables, components, and accessories for approval by the Contracting Officer. Include a cut-over plan with procedures and schedules for relocation of facility station numbers without interrupting service to any active location. Submit the plan at least 30 days prior to tests for Contracting Officer approval. Provide outside plant testing and performance measurement criteria in accordance with TIA-568-C.1 and RUS Bull 1753F-201. Include procedures for certification, validation, and testing that includes fiber optic link performance criteria.

1.6.4 Standard Products

Provide materials and equipment that are standard products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and shall be the manufacturer's latest standard design that has been in satisfactory commercial or industrial use for at least 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is provided.

1.6.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5.1 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.7 DELIVERY, STORAGE, AND HANDLING

Ship cable on reels in with a minimum overage of 10 percent. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, and date of manufacture. Provide water resistant label and the indelible writing on the labels. Apply end seals to each end of the cables to prevent moisture

from entering the cable. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Equipment, other than cable, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants in accordance with manufacturer's requirements.

1.8 MAINTENANCE

1.8.1 Record Documentation

Provide the activity responsible for telecommunications system maintenance and administration a single complete and accurate set of record documentation for the entire telecommunications system with respect to this project.

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in hard copy format and on electronic media using Windows based computer cable management software. Provide the following T5 drawing documentation as a minimum:

- a. Cables - A record of installed cable shall be provided in accordance with TIA-606. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with TIA-606. Include manufacture date of cable with submittal.
- b. Termination Hardware - Provide a record of installed patch panels, cross-connect points, campus distributor and terminating block arrangements and type in accordance with TIA-606. Documentation shall include the required data fields as a minimum in accordance with TIA-606.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems.

2.2 TELECOMMUNICATIONS ENTRANCE FACILITY

2.2.1 Building Protector Assemblies

Provide self-contained 5 pin unit supplied with a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for pairs of outside cable indicated on drawings. Building protector assembly shall have interconnecting hardware for connection to

interior cabling at full capacity. Provide manufacturers instructions for building protector assembly installation. Provide copper cable interconnecting hardware as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.2.2 Protector Modules

Provide in accordance with UL 497 solid state type 5 pin rated for the application. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.2.3 Fiber Optic Terminations

Provide fiber optic cable terminations as specified in 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.3 CLOSURES

2.3.1 Copper Conductor Closures

2.3.1.1 Underground Cable Closures

- a. In vault or manhole: Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing. Closure shall be stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment.

2.4 CABLE SPLICES, AND CONNECTORS

2.4.1 Copper Cable Splices

Provide multipair, in-line splices of a moisture resistant, insulation displacement connector held rigidly in place to assure maximum continuity in accordance with RUS Bull 1753F-401. Cables greater than 25 pairs shall be spliced using multipair splicing connectors, which accommodate 25 pairs of conductors at a time. Provide correct connector size to accommodate the cable gauge of the supplied cable.

2.4.2 Fiber Optic Cable Splices

Provide fiber optic cable splices and splicing materials for fusion methods at locations shown on the construction drawings. The splice insertion loss shall be 0.3 dB maximum when measured in accordance with TIA-455-78-B using an Optical Time Domain Reflectometer (OTDR). Splices shall be designed for a return loss of 40.0 db max for single mode fiber when tested in accordance with TIA-455-107. Physically protect each fiber optic splice by a splice kit specially designed for the splice.

2.4.3 Fiber Optic Splice Organizer

Provide splice organizer suitable for housing fiber optic splices in a neat and orderly fashion. Splice organizer shall allow for a minimum of 3 feet of fiber for each fiber within the cable to be neatly stored without kinks or twists. Splice organizer shall accommodate individual strain relief for each splice and allow for future maintenance or modification, without damage to the cable or splices. Provide splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors in a splice organizer kit.

2.4.4 Shield Connectors

Provide connectors with a stable, low-impedance electrical connection between the cable shield and the bonding conductor in accordance with RUS Bull 345-65.

2.5 CONDUIT

Provide conduit as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.6 PLASTIC INSULATING TAPE

UL 510.

2.7 WIRE AND CABLE

2.7.1 Copper Conductor Cable

Solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. Cable shall be completed by the application of a suitable core wrapping material, a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket. Telecommunications contractor shall verify distances between splice points prior to ordering cable in specific cut lengths. Gauge of conductor shall determine the range of numbers of pairs specified; 19 gauge (6 to 400 pairs), 22 gauge (6 to 1200 pairs), 24 gauge (6 to 2100 pairs), and 26 gauge (6 to 3000 pairs). Copper conductor shall conform to the following:

2.7.1.1 Underground

Provide filled cable meeting the requirements of ICEA S-99-689 and RUS 1755.890.

2.7.1.2 Screen

Provide screen-compartmental core cable filled cable meeting the requirements of ICEA S-99-689 and RUS 1755.390.

2.7.2 Fiber Optic Cable

Provide single-mode, 8/125-um, 0.10 aperture 1550 nm fiber optic cable in accordance with TIA-492E000, TIA-472D000, and ICEA S-87-640 including any special requirements made necessary by a specialized design. Provide optical fibers as indicated. Fiber optic cable shall be specifically designed for outside use with loose buffer construction. Provide fiber optic color code in accordance with TIA/EIA-598

2.7.2.1 Strength Members

Provide central, non-metallic strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with ICEA S-87-640. The strength member is included to serve as a cable core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.

2.7.2.2 Performance Requirements

Provide fiber optic cable with optical and mechanical performance requirements in accordance with ICEA S-87-640.

2.7.3 Grounding and Bonding Conductors

Provide grounding and bonding conductors in accordance with RUS 1755.200, TIA-607, IEEE C2, and NFPA 70. Solid bare copper wire meeting the requirements of ASTM B1 for sizes No. 8 AWG and smaller and stranded bare copper wire meeting the requirements of ASTM B8, for sizes No. 6 AWG and larger. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of UL 83.

2.8 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each telecommunications cable or wire located in manholes, handholes, and vaults. Cable tags shall be polyethylene and labeled in accordance with TIA-606. Handwritten labeling is unacceptable.

2.8.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

2.9 BURIED WARNING AND IDENTIFICATION TAPE

Provide fiber optic media marking and protection in accordance with TIA-590. Provide color, type and depth of tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 23 00.00 20 EXCAVATION AND FILL.

2.10 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.11 FIELD FABRICATED NAMEPLATES

Provide laminated plastic nameplates in accordance with ASTM D709 for each patch panel, protector assembly, rack, cabinet and other equipment or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.12 TESTS, INSPECTIONS, AND VERIFICATIONS

2.12.1 Factory Reel Test Data

Test 100 percent OTDR test of FO media at the factory in accordance with TIA-568-C.1 and TIA-568-C.3. Use TIA-526-7 for single mode fiber and TIA-526-14 Method B for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Enhanced performance filled OSP copper cables, referred to as Broadband Outside Plant (BBOSP), shall meet the requirements of ICEA S-99-689. Enhanced performance air core OSP copper cables shall meet the requirements of ICEA S-98-688. Submit test reports, including manufacture date for each cable reel and receive approval before delivery of cable to the project site.

2.13 Outdoor Telecommunications Cabinet

Free-standing single dual access type 4X 14 gauge, 316L stainless steel enclosure. Enclosure is to have 19 inch rails in accordance with EIA RS-310-D for mounting of telecommunications equipment. Enclosure must have a two door construction that opens in the front and rear. Design is to be unibody with seams continuously welded and ground smooth. Doors are to have a heavy duty three point latching mechanism operated by 316L stainless steel padlocking handles. A seamless foam-in-place gasket is to be provided on the door to create a water tight IP66 compliant seal. A grounding bar system is to be provided with the enclosure and bonded to the enclosure door using a #6 AWG green insulated wire.

2.14 Outdoor Telecommunications Enclosures

Manufactured from 316L stainless steel with hidden hinges and a foam-in-place gasket for a water tight IP66 compliant seal. Panel mounting studs with conductive panel for mounting of equipment. Quarter turn latches with a flush slotted insert. Enclosure is to be NEMA 4X rated with a solid front door. Sizes as indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions IEEE C2, NFPA 70, and as indicated. Provide all necessary interconnections, services, and adjustments required for a complete and operable telecommunications system.

3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the Contracting Officer of damage.

3.1.2 Cable Inspection and Repair

Handle cable and wire provided in the construction of this project with care. Inspect cable reels for cuts, nicks or other damage. Damaged cable

shall be replaced or repaired to the satisfaction of the Contracting Officer. Reel wraps shall remain intact on the reel until the cable is ready for placement.

3.1.1.3 Underground Duct

Provide underground duct and connections to existing manholes, as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION with any additional requirements as specified herein.

3.1.1.4 Reconditioning of Surfaces

Provide reconditioning of surfaces as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.1.1.5 Penetrations

Caulk and seal cable access penetrations in walls, ceilings and other parts of the building. Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.1.6 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of cables. Fiber must be one continuous pull with no underground splices. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on cables when entering or leaving the manhole. Do not place cables in ducts other than those shown without prior written approval of the Contracting Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up cable reels on the same side of the manhole as the conduit section in which the cable is to be placed. Level the reel and bring into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the cable be paid off from the bottom of a reel. Check the equipment set up prior to beginning the cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between cable reel and face of duct to protect cable and guide cable into the duct as it is paid off the reel. As cable is paid off the reel, lubricate and inspect cable for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Cable pulling shall also be stopped when reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide cable lubricants recommended by the cable manufacturer. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

3.1.6.1 Cable Tensions

Obtain from the cable manufacturer and provide to the Contracting Officer, the maximum allowable pulling tension. This tension shall not be exceeded.

3.1.6.2 Pulling Eyes

Equip cables 1.25 inches in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide cables with diameter smaller

than 1.25 inches with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Rings to prevent grip from slipping shall not be beaten into the cable sheath. Use a swivel of 3/4 inch links between pulling-in eyes or grips and pulling strand.

3.1.6.3 Installation of Cables in Manholes, Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support cables on brackets and cable insulators at a maximum of 4 feet. In existing manholes, handholes, and vaults where new ducts are to be terminated, or where new cables are to be installed, modify the existing installation of cables, cable supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed metal tags.

3.1.7 Cable Splicing

All cable splicing into existing shall be performed by base communications personnel. All new cabling splices shall be performed by the contractor.

3.1.7.1 Copper Conductor Splices

Perform splicing in accordance with requirements of RUS Bull 1753F-401 except that direct buried splices and twisted and soldered splices are not allowed. Exception does not apply for pairs assigned for carrier application.

3.1.7.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with manufacturer's recommendation and shall exhibit an insertion loss not greater than 0.2 dB for fusion splices. Fiber optic cabling shall have no splices in manholes or handholes.

3.1.8 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end which meet the requirements of RUS Bull 1751F-815.

3.1.9 Grounding

Provide grounding and bonding in accordance with RUS 1755.200, TIA-607, IEEE C2, and NFPA 70. Ground exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals.

3.1.10 Cut-Over

All necessary transfers and cut-overs, shall be accomplished by base communication group. Contractor must coordinate any cut-over or transfer requirement with the contracting officer.

3.1.11 Seismic Installation Requirements

Provide per 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

3.2 LABELING

3.2.1 Labels

Provide labeling for new cabling and termination hardware located within the facility in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware shall be provided using thermal ink transfer process.

3.2.2 Cable Tag Installation

Install cable tags for each telecommunications cable or wire located in manholes, handholes, and vaults including each splice. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The labeling of telecommunications cable tag identifiers shall be in accordance with TIA-606. Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

3.2.3 Termination Hardware

Label patch panels, distribution panels, connector blocks and protection modules using color coded labels with identifiers in accordance with TIA-606.

3.3 FIELD APPLIED PAINTING

Provide ferrous metallic enclosure finishes in accordance with the following procedures. Ensure that surfaces are dry and clean when the coating is applied. Coat joints and crevices. Prior to assembly, paint surfaces which will be concealed or inaccessible after assembly. Apply primer and finish coat in accordance with the manufacturer's recommendations.

3.3.1 Cleaning

Clean surfaces in accordance with SSPC SP 6/NACE No.3.

3.3.2 Priming

Prime with a two component polyamide epoxy primer which has a bisphenol-A base, a minimum of 60 percent solids by volume, and an ability to build up a minimum dry film thickness on a vertical surface of 5.0 mils. Apply in two coats to a total dry film thickness of 5 to 8 mils.

3.3.3 Finish Coat

Finish with a two component urethane consisting of saturated polyester polyol resin mixed with aliphatic isocyanate which has a minimum of 50 percent solids by volume. Apply to a minimum dry film thickness of 2 to 3 mils. Color shall be the manufacturer's standard.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 FIELD QUALITY CONTROL

Provide the Contracting Officer 10 working days notice prior to each test. Provide labor, equipment, and incidentals required for testing. Correct defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the Contracting Officer within 3 working days after the tests for each segment of construction are completed. Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

3.5.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

3.5.1.1 Cable Capacitance

Perform capacitance tests of the pairs within a cable to determine if cable capacitance is within the limits specified.

3.5.1.2 Loop Resistance

Perform DC-loop resistance of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

3.5.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the Contracting Officer at least 5 working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable, pairs tested, and recorded readings. When pre-installation tests indicate that cable does not meet specifications, remove cable from the job site.

3.5.2 Acceptance Tests

Perform acceptance testing in accordance with RUS Bull 1753F-201 and as further specified in this section. Provide personnel, equipment, instrumentation, and supplies necessary to perform required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test unless specified otherwise. Testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. Test plans shall define the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested. Provide test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis. Perform test on 10 percent of copper pairs in each 25-pair binder group. Stagger tested pairs evenly among 25-pair binder groups. Do not test 10 percent of pairs sequentially.

3.5.2.1 Copper Conductor Cable

Perform the following acceptance tests in accordance with TIA-758:

- a. Wire map (pin to pin continuity)
- b. Continuity to remote end
- c. Crossed pairs
- d. Reversed pairs
- e. Split pairs
- f. Shorts between two or more conductors

3.5.2.2 Fiber Optic Cable

Test fiber optic cable in accordance with TIA/EIA-455 and as further specified in this section. Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. These tests shall be performed on the completed end-to-end spans.

- a. OTDR Test: The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings or improper splices for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, 66 feet minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in accordance with TIA-526-7 for single-mode fiber. Splice losses shall not exceed 0.3 db.
- b. Attenuation Test: End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 850, 1300, 1310, 1550 nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with TIA-455-46A for multimode and TIA-526-7 for single-mode fiber optic cables. The measurement method shall be in accordance with TIA-455-78-B. Attenuation losses shall not exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber.

3.5.3 Soil Density Tests

- a. Determine soil-density relationships for compaction of backfill material in accordance with ASTM D1557, Method D.

3.6 Special Testing for Seismic-Resisting Equipment

Equipment and components designated as MC-1 (Mission Critical Level 1) Designated Seismic Systems required to remain operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise. Seismic component qualification documentation for each piece of equipment must contain the information required in UFC 3-301-02, Section 2-17.2.5 Component Qualification Documentation.

Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be less than 5 inches by 7 inches with red letters 1-inch in height on a white background stating "Certified Equipment". The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file". The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

3.7 Special Inspection for Seismic-Resisting Systems and Equipment

Perform special inspections for seismic-resisting systems, equipment and components for structures assigned to Risk Category IV per Section 01 45 35 SPECIAL INSPECTIONS.

-- End of Section --

SECTION 34 71 13.16

VEHICLE CRASH BARRIERS
02/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 30	(2002; R 2010) Standard Specification for Zinc-Coated Steel Wire Rope and Fittings for Highway Guardrail
AASHTO M 180	(2012; R 2017) Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail
AASHTO MASH	(2016) Manual for Assessing Safety Hardware - Second Edition

ASTM INTERNATIONAL (ASTM)

ASTM A1	(2000; R 2018) Standard Specification for Carbon Steel Tee Rails
ASTM A27/A27M	(2020) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A242/A242M	(2013; R 2018) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A449	(2014) Standard Specification for Hex Cap

Screws, Bolts, and Studs, Steel, Heat
Treated, 120/105/90 ksi Minimum Tensile
Strength, General Use

ASTM A499	(2015, R 2020) Standard Specification for Steel Bars and Shapes, Carbon Rolled from "T" Rails
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A568/A568M	(2019a) Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A588/A588M	(2019) Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A1035/A1035M	(2020) Standard Specification for Deformed and Plain, Low-carbon, Chromium, Steel Bars for Concrete Reinforcement
ASTM B695	(2004; R 2016) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C94/C94M	(2020) Standard Specification for Ready-Mixed Concrete
ASTM D4956	(2013) Standard Specification for Retroreflective Sheeting for Traffic Control
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

NCHRP 350	(1993) Recommended Procedures for the Safety Performance Evaluation of Highway Features
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING.

Submit the following in accordance with Section 01 33 00 SUBMITTAL

PROCEDURES:

SD-03 Product Data

FHWA Acceptance Letter

SD-08 Manufacturer's Instructions

End Anchorage

Submit at least 14 days prior to installation.

Crash Cushion

Submit at least 14 days prior to installation.

PART 2 PRODUCTS

2.1 GUARDRAIL POSTS

Guardrail posts must be either wood or steel and of the dimensions indicated. Unless otherwise indicated, use only one type of post throughout the project.

2.1.1 Sawn Wood Posts and Offset Blocks

Posts and offset blocks must be of stress grade and capable of resisting a working stress of 1600 psi on the extreme fibers when subjected to bending. Posts and blocks must be double end trimmed with the mounting bolt hole in each being drilled 1/16 inch oversize and within 1/2 inch of the specified location on either side of the post or block. All wood posts and offset blocks must be rough, free of wane, squarecut, and fully sawn to the dimensions indicated. Drill post bolt holes before preservative treatment is applied. Unless otherwise approved, use only one preservative on the project.

2.1.2 Steel Posts

Fabricate "H" beam sections from steel conforming to either ASTM A36/A36M, ASTM A588/A588M or ASTM A242/A242M and conforming to the size, weight and dimensions indicated. Use bolts must be of the diameters indicated. Bolts used with galvanized ASTM A36/A36M steel must conform to ASTM A307. ASTM F3125/F3125M, Type 3 bolts may be used with ASTM A588/A588M or ASTM A242/A242M steel without galvanizing. Galvanize bolts, posts, and all necessary hardware fabricated from ASTM A36/A36M steel in accordance with ASTM A123/A123M.

2.1.3 Polymer and Polymer Composite Offset Blocks

Provide polymer and polymer composite offset blocks certified by the Federal Highway Administration (FHWA) to meet the requirements of either NCHRP 350 or AASHTO MASH. Submit a copy of the FHWA Acceptance Letter.

2.2 W-BEAM GUARDRAIL

Provide galvanized steel beam guard rail elements and fittings of the indicated design and details. The finished steel beam elements must be Class A (base metal nominal thickness 0.105 inch and conform to the requirements of AASHTO M 180. Galvanizing of steel beam elements must be Type 1 (zinc coated 1.80 ounces per square foot, minimum single spot) and must conform to the requirements of AASHTO M 180.

2.3 "W" BEAM END SECTION

Provide "W" beam end sections of the same or greater thickness of metal and the same type as the beam to which it is attached.

2.4 GUARDRAIL HARDWARE

All fittings (bolts, nuts, washers, etc.) for guardrail must conform to the requirements of AASHTO M 180.

Bolt Use	Bolt Size and Configuration	
Rival Splices	5/8 inch diameter	Button head type with oval shoulder conforming to alternative No. 1 or 2 configuration of AASHTO M 180
Fastening Rail to Steel or Timber Blocks	5/8 inch diameter	Button head type with oval shoulder conforming to alternative No. 1 or 2 configuration of AASHTO M 180
Rail Splices	1.25 inches long	
Fastening Rail to Steel Block	2 inches long	Minimum thread length of 1.5 inches
Fastening Rail to Timber Block and Post	18 inches long	Minimum thread length of 2.5 inches
Fastening Steel Block to Post	1.5 inches long	5/8 inch diameter hex head type

2.5 TERMINAL FOR W-BEAM GUARDRAIL

Provide a flared terminal for w-beam guardrail. Provide terminal certified by the Federal Highway Administration (FHWA) to meet the requirements for Test Level 2 AASHTO MASH. Submit a copy of the FHWA Acceptance Letter.

2.6 CABLE BARRIER

2.6.1 Cable

Provide 3/4 inch, Type I, Class A coating in accordance with AASHTO M 30.

2.6.2 Cable Splices, Ends, Fittings

Design cable splices and ends capable of developing the full breaking strength of the cable (25,000 lbs). Cable ends must be cast steel or malleable iron. Cable wedges must be malleable iron and not be

galvanized. Conform cast steel fittings to ASTM A27/A27M, grade 70-36. Conform maleable iron fittings to ASTM A47/A47M. Galvanize cable splices, ends, and fittings in accordance with ASTM A123/A123M.

2.6.3 Compensating Device

Provide compensating devices with a spring rate of 450 lbs plus or minus 50 lbs per inch and a minimum total available travel of 6 inches. Galvanize all parts in accordance with ASTM A153/A153M.

2.6.4 Hook Bolts

Provide hook bolts conforming to ASTM A307 Grade A with a tensile strength of 60 ksi and a yield strength of 36 ksi. Provide corrosion-resistant bolts manufactured from ASTM F3125/F3125M Type 3 material, with a tensile strength of 120 ksi and a yield strength of 92 ksi. Hook bolts must develop an ultimate pull open strength, applied in a direction normal to the longitudinal axis of the post, from 500 to 1000 pounds. Use galvanized nuts conforming to ASTM A563 Grade A. Use corrosion-resistant nuts conforming to ASTM A563 Grade C3. Finish galvanized bolts and nuts according to ASTM A153/A153M for Class C or ASTM B695 for Class 50. If galvanized, overlap the threads as specified in ASTM A563.

2.6.5 Steel Posts

2.6.5.1 Structural Steel Posts

Provide structural steel posts and anchor plates conforming to ASTM A36/A36M. Galvanize in accordance with ASTM A123/A123M.

2.6.5.2 Flanged Channel Posts

Fabricate flanged channel posts from rerolled rail steel bars conforming to ASTM A499, Grade 60 except that the minimum yield strength must be. The post must meet the chemical properties of ASTM A1 for rails 30 pounds per foot and heavier.

2.6.6 Anchor Assembly

Provide anchor posts and anchor post plates conforming to ASTM A36/A36M. Galvanize anchor posts, and anchor post plates after fabrication in accordance with ASTM A123/A123M. Provide steel conforming to ASTM A449 or ASTM A568/A568M and galvanize the top 6 inches in accordance with ASTM A123/A123M. Provide hex nuts conforming to ASTM A563.

2.6.7 Concrete

ASTM C94/C94M, using 3/4 inch maximum aggregate, and having minimum compressive strength of 4000 psi at 28 days. Reinforcing steel must be deformed bars conforming to ASTM A615/A615M, ASTM A706/A706M, or ASTM A1035/A1035M grade 40.

2.7 RETROREFLECTIVE SHEETING

Provide retroreflective sheeting conforming to ASTM D4956, Type III. All retroreflective sheeting must have a precoated adhesive which will permanently adhere to the metal surface.

PART 3 EXECUTION

3.1 POSTS

Posts may be placed by driving or by setting in excavated holes. Post holes for guardrail posts must be round and at least 4 inches larger, in diameter, than the greater dimensions (not the diagonal) of the posts, and must be backfilled around the posts with material removed or other suitable soil, placed in lifts not exceeding 4 inches, each lift thoroughly tamped. When placed by driving, drive the posts plumb, to the depth and in the position indicated. Remove posts which are broomed, split or damaged in any other way and replace with a sound post. Carry on driving operations in such manner that nearby structures, shoulders, or pavements are not damaged. Cuts and abrasions in preservative-treated posts and blocks must have the newly exposed surfaces treated with at least three applications of the same type of preservative with which the material was originally treated. Each application must be reasonably dry before the succeeding coat is applied. At the time a timber post is installed, any seasoning check which extends the full length of the piece cannot exceed 1/4 inch in width. Adjust posts used for vertical transition in length so that a minimum of 60 inches will be buried. Where guardrail cross buried structures and 60 inches of bury is not obtainable, install the guardrail post as deep as possible and with a 24 inch diameter concrete encasement for the full depth of bury.

3.2 GUARDRAIL BEAM ELEMENTS

Place and fasten the beam elements, fittings, and other parts of the guardrail as indicated. Erect the elements to produce a smooth, even rail, closely conforming to a line and grade parallel to the pavement. Bolt the beam elements to each post, and make splices by lapping in the direction of traffic. Splice only at posts. Where the rail is on a curve, the beams at the splice must make contact throughout the area of the splice, forming a continuous beam before erection. On curves of 150 foot radius or less, install shop bent beam elements, bent to the radius indicated. Tighten all bolts in the finished rail.

3.3 GUARDRAIL DELINEATOR REFLECTOR TABS

Clean, degrease and etch the face of metal tabs using methods recommended by the retroreflective sheeting manufacturer. After cleaning and degreasing, apply retroreflective sheeting material to the metal tabs as recommended by the manufacturer. Perform shearing, cutting and punching prior to preparing the blanks for application of reflective material.

3.4 GUARDRAIL END ANCHORAGE

Install flared and non-flared end anchorages in accordance with the manufacturer's instructions. Submit a copy of the manufacturer's end anchorage installation instructions prior to installation.

3.5 CRASH CUSHION

Assemble and install crash cushions as indicated and in accordance with the manufacturer's instructions. Submit a copy of crash cushion manufacturer's installation instructions.

-- End of Section --

SECTION 35 51 13

CONCRETE FLOATING DOCK SYSTEM FOR SMALL CRAFT
05/21

PART 1 GENERAL

1.1 Scope of Section

This section is a bid option for the floating dock system. If the option is not exercised, then this section will not apply to this project.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA ADM (2020) Aluminum Design Manual

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 211.2	(1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 301	(2016) Specifications for Structural Concrete
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305.1	(2014; R 2020) Specification for Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 308.1	(2011) Specification for Curing Concrete
ACI 309R	(2005) Guide for Consolidation of Concrete
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.21.1 (2009; R 2016) Washers: Helical
Spring-Lock, Tooth Lock, and Plain Washers
(Inch Series)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M (2014; Errata 1 2014; Errata 2 2020)
Structural Welding Code - Aluminum

AWS D1.4/D1.4M (2018) Structural Welding Code -
Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon
Structural Steel

ASTM A123/A123M (2017) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products

ASTM A153/A153M (2016a) Standard Specification for Zinc
Coating (Hot-Dip) on Iron and Steel
Hardware

ASTM A276/A276M (2017) Standard Specification for
Stainless Steel Bars and Shapes

ASTM A307 (2021) Standard Specification for Carbon
Steel Bolts, Studs, and Threaded Rod 60
000 PSI Tensile Strength

ASTM A449 (2014; R 2020) Standard Specification for
Hex Cap Screws, Bolts, and Studs, Steel,
Heat Treated, 120/105/90 ksi Minimum
Tensile Strength, General Use

ASTM A563 (2015) Standard Specification for Carbon
and Alloy Steel Nuts

ASTM A563M (2007; R 2013) Standard Specification for
Carbon and Alloy Steel Nuts (Metric)

ASTM A572/A572M (2021; E 2021) Standard Specification for
High-Strength Low-Alloy Columbium-Vanadium
Structural Steel

ASTM A615/A615M (2020) Standard Specification for Deformed
and Plain Carbon-Steel Bars for Concrete
Reinforcement

ASTM A706/A706M (2016) Standard Specification for
Low-Alloy Steel Deformed and Plain Bars

	for Concrete Reinforcement
ASTM A767/A767M	(2019) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(2020) Standard Specification for Structural Steel Shapes
ASTM A1022/A1022M	(2016b) Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement
ASTM A1064/A1064M	(2018a) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM C150/C150M	(2021) Standard Specification for Portland Cement
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C272/C272M	(2018) Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions
ASTM C330/C330M	(2017a) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C578	(2019) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C595/C595M	(2021) Standard Specification for Blended Hydraulic Cements

ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D1535	(2014; R 2018) Standard Practice for Specifying Color by the Munsell System
ASTM D2241	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D4020	(2011) Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials
ASTM F436/F436M	(2019) Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
ASTM F593	(2017) Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	(2009; R 2020) Standard Specification for Stainless Steel Nuts
ASTM F844	(2019) Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM G109	(2007; R 2013) Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments E(2000)

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60529	(1989; A1 2013; C1 2019) Degrees of Protection Provided By Enclosures (IP Code)
IEC 60309-1	(1999; A1 2005; A2 2012) Plugs, Socket-Outlets and Couplers for Industrial Purposes Part 1: General Requirements
IEC 60309-2	(1999; A2 2012) Plugs, Socket-Outlets and Couplers for Industrial Purposes Part 2: Dimensional Interchangeability Requirements for Pin and Contact-Tube Accessories

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal
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Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1993; R 2016) Industrial Control and
Systems: Enclosures

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116 (1999) Manual for Quality Control for
Plants and Production of Structural
Precast Concrete Products, 4th Edition

PCI MNL-120 (2021) PCI Design Handbook - Precast and
Prestressed Concrete, 8th Edition

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-QQ-A-200/8 (1997; R 2012) Aluminum Alloy 6061, Bar,
Rod, Shapes, Tube, and Wire, Extruded

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-I-24768/14 (1992; Notice 1 2020) Insulation, Plastic,
Laminated, Thermosetting,
Cotton-Fabric-Base, Phenolic-Resin (FBG)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-55619 (Rev C; Notice 1) Casters, Industrial,
Heavy Duty

UNDERWRITERS LABORATORIES (UL)

UL 98 (2016) UL Standard for Safety Enclosed and
Dead-Front Switches

UL 231 (2016; Reprint Jan 2021) UL Standard for
Safety Power Outlets

UL 489 (2016; Rev 2019) UL Standard for Safety
Molded-Case Circuit Breakers, Molded-Case
Switches and Circuit-Breaker Enclosures

UL 943 (2016; Reprint Feb 2018) UL Standard for
Safety Ground-Fault Circuit-Interrupters

UL 1686 (2012; Reprint Jan 2014) Standard for Pin
and Sleeve Configurations

1.3 DEFINITIONS

- a. "Anchorage System" is the dock restraint system such as guide piling, ground anchor system, strut-to-shore system, etc. including connections.
- b. "Contractor" is responsible for the design, manufacturing, and installation of a complete floating dock system.

- c. "Design strength" (f'c) is the specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.
- d. "Dock Accessories" are elements not considered part of the float system and include but are not limited to fenders, dock boxes, electrical and mechanical equipment, security features, and means of securing mooring lines.
- e. "Finger Pier" is a float structure extending perpendicular to the main pier allowing access to the side of the vessel.
- f. "Float System" is a system of floating dock modules structurally connected to transfer loads to the anchorage system. The float system includes the connection hardware and structural weldments to shore.
- g. "Gangway" is an articulating ramp providing a connection from land to a floating dock.
- h. "Main Pier" is the primary access float system extending perpendicular or at an angle from marginal/main walkway or shoreline for passage between the shore and boat slips, providing access to shore.
- i. "Manufacturer" is a subcontractor to the Contractor and is the party responsible for the design and fabrication of the floating dock system, including connection to the anchorage system and gangway system. Unless specified otherwise in the Contract Documents, the dock Manufacturer is not responsible for the design of the anchorage system.
- j. "Marginal Walkway" or "Main Walkway" is the principal collector float system of branching main piers that is connected to shore.
- k. "Military Craft" is a vessel used for military operations and services.
- l. "Non-Operational" is a non occupancy case with nonroutine functionality and inactive use such as an extreme storm event where boats are removed from the small craft harbor.
- m. "Operational" is an occupancy case with routine functionality and active use.
- n. "Recreational Craft" is a noncommercial vessel used by recreational users.
- o. "Service life" is the Contracting Officer's stated expectation for the number of years that the structure will function without needing major rehabilitation or replacement.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00
SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Procedures; G

Contractor Qualifications

Manufacturer Qualifications

SD-02 Shop Drawings

Floating Dock System; G

Reinforcing Steel

Gangways; G

Utility Routing; G

All-Purpose Pedestals; G

Receptacle Stations; G

SD-03 Product Data

Concrete Mix Design; G

Grout; G

Reinforcement; G

Metal Accessories; G

Cleats; G

Dock Fenders; G

Ladders

Gangway Materials

Receptacle Stations; G

All-Purpose Pedestals; G

Concrete Curing

Guide Pile Rub Blocks And Rollers; G

SD-05 Design Data

Floating Dock System Design Calculations; G

Gangway Calculations; G

Concrete Mix Design; G

SD-06 Test Reports

Concrete Mix Design

Fasteners

Reinforcement

Metal Accessories

Foam Core

Coatings; G

SD-07 Certificates

Float Fabrication

Rubbing Surface

Paint Coating System; G

SD-10 Operation and Maintenance Data

Floating Dock System Operation And Maintenance Manual; G

SD-11 Closeout Submittals

Warranty

1.5 SYSTEM DESCRIPTION

The work includes the design, fabrication, and installation of a complete floating dock system that consists of precast, non-prestressed concrete float modules herein referred to as precast floats and all other items relating to the precast floating dock system including, but not limited to the dock framework, anchorage system, connecting hardware, accessories, provisions for utility routing, and gangways. The dock system must consist of modular reinforced concrete floats connected to form continuous sections of a floating dock system. The floating dock system must be designed by the Contractor to meet all requirements of the drawings and this specification.

1.6 QUALITY CONTROL

Prior to ordering the dock system, submit quality control procedures to be used during the design, manufacturing, and installation of the floating dock system.

1.6.1 Qualifications

Submit experience data verifying required years of experience in the manufacturing and installation of concrete floating dock systems within reference projects. For each reference project, provide project name, location, date of installation, and Owner including the name, address, phone number of a person who can be contacted for verification.

1.6.1.1 Manufacturer Qualifications

Precast float system must be the product of a Manufacturer specializing in the production of precast floats with a minimum of 10 years' experience in the manufacturing of precast concrete floating docks. The float system design must have been successfully installed for a minimum of 5 years at another location with comparable environmental exposure.

1.6.1.2 Contractor Qualifications

Contractor installing the float system must have a minimum of 10 years' experience in the installation of similar float systems, with a minimum of 2 installations in the past 10 years.

1.6.2 Product Quality Control

PCI MNL-116. Where precast floats are manufactured in a plant with an established quality control program as attested to by a current certification in the PCI "Certification Program for Quality Control", perform quality control in accordance with PCI MNL-116.

Where precast floats are manufactured by specialists or in plants not currently enrolled in the PCI "Quality Control Program," provide a product quality control system equivalent to PCI MNL-116 and perform concrete and aggregate quality control testing using independent commercial testing laboratory approved by the Contracting Officer. If a non-conformance is encountered, the Contractor must notify the Contracting Officer immediately and recommend a change in materials or procedure to resolve the non-conformance to the satisfaction of the Contracting Officer.

1.6.3 Factory Inspection

At the option of the Contracting Officer, precast floats may be inspected by the QC Representative prior to being transported to the job site. The Contractor must give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.6.4 Product Records

Submit a complete and accurate record of all floats manufactured for the project. The record must include assigned float identification number, date cast, related concrete cylinder strength tests, and all quality assurance tests and inspection items performed on the float.

1.6.5 Product Testing

Submit a complete and accurate record of test procedures, methodology, equipment, and results for each test specified.

1.7 DELIVERY AND STORAGE

1.7.1 Storage Requirements

Contractor must lift precast floats at the lifting points indicated on the shop drawings. Store precast floats off the ground on support points indicated on the shop drawings. Separate stacked precast floats by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload. Deliver the materials to the project site and store in a safe area out of way of traffic and shored up off the ground surface. Use extreme care in the loading, unloading, and transporting materials to prevent damage.

1.7.2 Identification

Place identification numbers on float (such they are not covered up after assembly) that conform to the shop drawing numbering system. Identify hardware, framework, and accessories, and store separately from each other. Protect all metal products with adequate weatherproof outer wrappings.

1.7.3 Repairs

In the event of damage caused by the Contractor, make repairs and/or replacements as necessary to the satisfaction of the Contracting Officer at no additional contract cost.

1.8 QUALITY ASSURANCE

1.8.1 Shop Drawings

Submit floating dock system shop drawings indicating complete information for the fabrication, handling, and erection of the floating dock system. The shop drawings must indicate the proposed float layout and slip size, float dimensions, float construction details, connection details, anchorage, and location and methods for attaching utilities and dock accessories. Submit shop drawings for all specially fabricated items including weldments and hardware, gangways, railing, curbing, and cleat installation. Drawings must not be reproductions of contract drawings. Shop drawings must be prepared and sealed by a registered Professional Engineer and submitted for approval prior to fabrication. The drawings must indicate, as a minimum, the following information:

- a. Floating dock system layout
- b. Marking of floats for assembly
- c. Connections between floats, and connections between floats and other construction
- d. Location and anchorage of mooring fittings
- e. Reinforcing steel details
- f. Material properties of all materials used
- g. Lifting and assembly inserts and embedded items
- h. Dimensions and surface finishes of each float
- i. Erection sequence and handling requirements
- j. All loads used in design (such as live, dead, wind, current, berthing, handling, and erection)
- k. Bracing/shoring methods of temporary support
- l. Gangways, gangway wheel load distribution, and connections
- m. Utility routing, receptacle stations, all-purpose pedestals, and connections for work of other trades

- n. Anchorage system layout with size, type, length, and location of each component

1.8.2 Design Calculations

Submit final floating dock system design calculations demonstrating the dock system conforms to the minimum requirements outlined in this specification. Design calculations (including connections, anchorage, and gangways) must be prepared and sealed by a registered Professional Engineer and submitted for approval prior to fabrication. The calculations for the dock system include but are not limited to:

- a. Overall system loads under full occupancy, with consideration for shielding factors, and deflection of the system and its effects on the anchorage system
- b. Anchorage system capacity for individual and overall load considerations
- c. Capacity of embedded items used to resist stresses encountered during casting, transporting, handling and erection
- d. Anchorage system overall dimensions, elevations, cross sections, minimum embedment, and minimum test loads
- e. Determination of extreme fiber stresses in structural members for all load cases
- f. Stresses in the dock system connections for all load cases
- g. Transfer of moored vessel forces to the dock system
- h. Freeboard calculations for all floats
- i. Gangway calculations for fixed and movable gangways, and all load cases

1.8.3 Manufactured Items

Submit catalog cut sheets for all standard manufactured items that are to be incorporated into the floating system. All materials must be suitable for sustained use in the marine environment for the design life of the structure.

1.8.4 Concrete Mix Design

Minimum thirty days prior to concrete placement, submit a concrete mix design for each strength and type of concrete. Include a complete list of materials including amount, type, brand, source, weight and admixtures with applicable catalog cut sheets. Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval from the Contracting Officer before concrete placement.

1.9 Warranty

Furnish the Manufacturer's warranty. The warranty must be issued directly to the Government and not be limited in dollar value. The individual dock floats must carry a warranty against defects in materials and workmanship for a period of five years from the date of project acceptance. All other

dock system components including structural members and accessory items must carry a Manufacturer's warranty against defects in materials and workmanship for a minimum of one year from the date of Government acceptance of the work. If, within the respective warranty periods, any materials or their installation are found to be defective, the Contractor must repair or replace the defective item at no cost and to the satisfaction of the Contracting Officer. The warranty excludes coverage for damage caused by abuse, misuse or neglect, and improper maintenance unless warranty period maintenance by the Manufacturer is included.

1.9.1 Warranty Maintenance

The Contractor must provide warranty maintenance for the duration of the warranty period for the dock system and include the cost therefore in the bid price.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.1.1 Design Life

The floating dock system, including all structural components of the systems, must be designed for a minimum 25 year life expectancy.

2.1.2 Dock System Performance

Floating dock system, including all structural components of the system, must be designed to withstand operational load conditions without damage. Contractor must consider that dock system will be occupied and in use during all operational conditions.

Floating dock system must be designed to survive the nonoperational conditions intact and in place such that the structure cannot breakaway or disconnect from the anchorage system. Dock system must be designed such that major structural connections maintain their structural integrity but does not preclude repair of individual components.

Dock system design must consider fatigue of all structural components over the design life of the dock system, including connections for deck mounted appurtenances.

2.1.3 Dock System Layout

The layout and principal dimensions of the floating dock system are indicated on the drawings. The Contractor must provide a system that conforms to the layout and dimensions indicated on the drawings and the provisions of this specification. Minor variances in dock dimensions to accommodate Manufacturer's standard products are acceptable to the layout and dimensions indicated on the drawings. All variances must be submitted by the Contractor to the Contracting Officer for approval prior to fabrication.

2.1.4 Dock System Design

The Contractor is responsible for the design of a complete floating dock system, including gangways

Float system must be made of a single reinforced concrete float.

2.1.5 Precast Concrete Float Design

ACI 318 and the PCI MNL-120. Precast float must consist of a reinforced concrete deck and a concrete or composite fully encased polystyrene core. The foam core must be fully encapsulated in concrete to prevent direct contact between the foam and the water and protect it from damage. A water impermeable product such as polyurea may be used in place of concrete for bottom surface of float only (if used, product shall wrap all sides of foam so encased by concrete side walls). Design float encapsulation to accommodate external factors such as salt intrusion, marine growth, and vessel operations. Design precast floats for handling without cracking in accordance with the PCI MNL-120.

2.1.5.1 Float Width

Precast floats must be sized so that a single float (excluding walers or rub strips) is used to attain the indicated dock width. The use of more than one float connected side by side to attain dock width is unacceptable.

2.1.5.2 Float Reinforcement

For floats subject to use by military craft, the design of the reinforced concrete side walls of the float should consider impact forces from vessel and must have a minimum reinforcement ratio not less than 0.2 percent.

2.1.6 Deck Freeboard

Deck freeboard under dead load only at the time of dock system acceptance must be between 24 and 30 inches with a tolerance of +/- 1 inch. Freeboard under combined dead load plus uniform live load must not be less than 12 inches.

2.1.7 Deck Tolerances

The floating dock system must be designed to float level under dead load and within the specified tolerances for live loads and environmental loads. The deck of the floats must be level and flush upon completion within the following tolerances.

- a. Dead load deck surface slope: Transverse direction not more than 1/8 inch per foot. Longitudinal direction not more than 1 inch per 10 feet of length and cumulatively maintain deck within specified freeboard limits.
- b. Vertical height difference between adjoining concrete floats, walers, rub trips, and deck panels: Maximum 1/4 inch on ADA Accessible Routes or 3/8 inch all others.

2.1.8 Utility Lines

The floating dock system must be designed so that utility main lines and electrical conduit sleeves embedded in the floats or in raceways remain a minimum of 4 inches above the water surface under dead load conditions to facilitate installation and servicing of the utilities. Access openings must be provided at convenient locations as required for access to service utilities. Utility main lines located on exterior surface must be shielded from direct sunlight and impact from floating debris or vessel operations. Utility main lines must remain a minimum of 4 inches above the

water surface under dead load conditions, unless lines are intentionally located underwater on the drawings. Water lines must have provisions for draining the system prior to freezing weather (winter).

2.1.9 Dock Anchorage System

The floating dock system must be designed to be supported by the anchorage system design indicated on the drawings. The floating dock system's connections to the anchorage system must be designed by the Contractor to accommodate all applicable load cases, movement tolerances, and the full range of design water levels depicted on the drawings.

2.1.9.1 Water Levels

Floating dock system is located in a salt tidally influenced water body, indicated guide pile elevation accounts for sea level change, and expected high water events.

A geotechnical data report that contains relevant soils information for design is to be available for review at the office of the Contracting Officer.

2.1.10 Gangway Design

The drawings depict a general layout and configuration of the gangway systems as well as required dimensions. Complete dimensions, which conform to these requirements, ADA and OSHA Regulations will be required by the fabricators. Gangways are subject to the same load conditions identified in the paragraph titled "DOCK LOADING".

Contractor must submit final design calculations for the gangway systems demonstrating that the gangways are designed to withstand the required loading for operational and non-operational conditions without damage throughout the specified design life.

2.1.10.1 Gangway Design Requirements

- a. Gangway must be aluminum fabrications. Coordinate the gangway systems design with the floating dock system design. Provide sufficient floatation to support the superimposed load of the gangway plus any appurtenances to maintain required freeboard. The gangway wheel assembly must not land within 1 ft of the edge of the concrete float at any water level.
- b. The deck and structural components must be designed with a minimum safety factor on working stress as specified in AA ADM for bridge type structures. For non-aluminum structural components, similar safety factors apply.
- c. Gangway design must consider stresses resulting from handling and installation, and provide notations on how to lift, unload, and set gangway in place.
- d. Maximum allowable deflection under vertical live load must not exceed $L/240$ where L is the gangway span length.

- e. The gangway must be ADA compliant and must conform to the ADA Guidelines for Recreational Boating Facilities, including length, slope, walking surface, and railing.
- f. The gangway system must conform in all respects to design requirements of OSHA rules for marinas and local codes as applicable. The gangway system must have a 36 inch high guardrail on each side of the walking surface (not including the transition plate), designed in accordance with ADA requirements. The rails must be fabricated of Schedule 80 aluminum pipe.
- g. Walking surface must be non-skid and resistant to staining by spills and dirt. OSHA recommends static Coefficient of Friction (COF) of 0.5 for walking surfaces. However, slip resistance varies from surface to surface, therefore any accessible floor must have a COF in accordance with OSHA and ANSI recommendations and should be in compliance with ADA guidelines.
- h. Gangway dock end connections must be designed to withstand float motions including vertical change in elevation due to water level fluctuation and horizontal movement without structure interference or overstress, including fatigue of gangway members, anchorage, and supports.
- i. Gangways must be fitted with hinged transition plates at float end to assure a safe uniform transition between gangway and deck surfaces. The gangway transition plate must make a smooth, gap-free transition between the gangway walking surface and the float. Each plate must be a minimum 1/4 inch thick aluminum plate with a non-skid surface and must be attached to the gangway by means of a continuous pipe hinge. The plate must be the full width of the gangway and have a maximum slope not exceeding the maximum slope of the gangway. Transition plates must be designed so as to not damage or mar the floating dock surface.
- j. Wheels must be installed at the float end of the gangway. Wheels must accommodate both lateral and longitudinal movement. The wheels must have an allowable load rating greater than that required by the design loads. The gangway design must allow the wheels to be supported by the floating dock at all times regardless of float motions. Where float end may rise above shore connection, either a second set of wheels may be installed, or the dock edge may be reinforced with a slide plate to support the gangway at high water levels.
- k. The gangway hinges must be designed to permit rotation of the gangway in both the vertical direction due to water level fluctuations and the horizontal direction due to lateral loads on the float and must accommodate float motions for all environmental conditions. The indicated hinge connections are double shear connections.
- l. Contact between aluminum and dissimilar metals or concrete must be avoided, except for the use of compatible stainless steel pins. Where potential for galvanic corrosion exists, the aluminum must be isolated from direct contact with other metals or concrete by use of suitable non-conducting insulators or bushings.

2.2 DOCK LOADING

Floating dock system must be designed for the following load and geometric conditions as a minimum. Load cases must be combined based upon their probability of simultaneous occurrence and in accordance with applicable codes and standards. Calculations must be performed for wind, current, and wave loads both parallel and perpendicular to the dock and dock anchorage system with consideration for differential movement between adjacent dock segments. Dock system must be stable and meet tolerances specified herein during both operational and nonoperation conditions.

2.2.1 Dead Load

Dead load, including all work of other trades, must consist of the weight of floats, framing, structural steel and timber miscellaneous connection devices, and all other permanently attached accessories such as utilities, dock boxes, fire suppression equipment, cleats, bumpers, etc. Contractor must exercise care to be sure that all dead loads are accurately determined and accounted for, including superimposed gangway system loads, consideration of weight gain due to water absorption, marine growth, and manufacturing tolerances that affect the final freeboard.

2.2.2 Vertical Live Load

- a. Uniform Live Load of 50 psf on dock, including the area of landings and gangways supported by the dock.
- b. Concentrated Live Load of 400 lbs applied at a location on the dock or gangway at least 12 inches from the edge.

2.2.3 Wind Load

Horizontal load acting on the projected side and end areas of vessels and docks.

- a. Occupied wind pressure of 15 psf for operational conditions (with vessels in place).
- b. Unoccupied (non-operational) wind pressure of 43 psf (without vessels in place).

2.2.3.1 Vessel Profile Area

- a. Vessel Profile Beam as indicated.
- b. Vessel Profile Height = 15 percent x length of vessel.

2.2.3.2 Wind Load Application

- a. Assume 100 percent berth occupancy.
- b. 100 percent applied to vessels in the unshielded berth; 20 percent applied to all vessels in the remaining (shielded) berths.

2.2.4 Current Load

- a. Current speed of 0.3 knots with and without vessels in place.

2.2.5 Wave Load

- a. Vertical wave load as determined from significant wave height (H_s) of 1.5ft. Wavelength equal to 16 ft, or the length of dock, whichever is less.
- b. Horizontal wave load as determined from 3.7 ft significant wave height.
- c. Wavelength equal to 16 ft, or the length of dock, whichever is less.
- d. Wave direction (propagation) perpendicular to longitudinal axis of dock.
- e. Docks must be analyzed for horizontal and vertical wave load in the unoccupied conditions.

2.2.6 Snow Load

- a. Uniform Snow Load of 30 psf on dock, including the area of landings, covered roofs, and gangways supported by the dock.

2.2.7 Vessel Impact Load

- a. Where vessel dock weight is not provided, vessel docking weight may be estimated as $12 \times L^2$ where L represents the vessel length in feet.
- b. Vessel draft = 10 percent $\times L$, where L represents the vessel length in feet.
- c. Vessel approach at a speed of 3 fps and an angle of 10 degrees from the axis of the dock.

2.2.8 Gangway Load

Superimposed dead load of the gangway structure and uniform live load on gangway tributary to the dock.

2.3 GANGWAY LOADING

- a. Dead load of the structure including utilities supported by gangway.
- b. Uniform Vertical Live Load of 50 psf on gangway.
- c. Horizontal line load of 50 plf on railing. Concentrated load of 200 lbs, applied at any location. Concentrated loads of 50 lbs on intermediate rails, pickets, and posts.
- d. Horizontal wind load from unoccupied wind speed applied over full profile area.

2.4 PRECAST FLOAT SYSTEM MATERIALS

ACI 211.1 or ACI 211.2, using weight method. The minimum compressive strength of concrete at 28 days must be 5000 psi with a minimum unit weight of 115 pcf dry. Mix must contain a corrosion inhibitor admixture. The maximum water-cement ratio must not exceed 0.40 and air-entraining admixtures at the mixer to produce between 2 to 8 percent air by volume in accordance with ASTM C173/C173M for freeze thaw exposure. The use of foaming agents is prohibited.

2.4.1 Concrete Mix Design

2.4.1.1 Portland Cement

ASTM C150/C150M, Type I/II; or ASTM C595/C595M Type IP(MS) or IS(MS) blended cement, except as modified herein. The blended cement must consist of a mixture of ASTM C150/C150M cement and one of the following materials: ASTM C618 fly ash or ASTM C989/C989M ground iron blast furnace slag. The fly ash content must not be less than 15 percent nor exceed 25 percent by total mass of cementitious material. The content of ground granulated blast-furnace slag must not exceed 50 percent of the mass of cement. The minimum amount of portland cement is 50 percent of the total mass of cementitious material. Use one Manufacturer for each type of cement, ground slag, and fly ash.

2.4.1.2 Fly Ash

ASTM C618, Type F, except that the maximum allowable loss on ignition must be 6 percent for Type F.

2.4.1.3 Ground Iron Blast-Furnace Slag

ASTM C989/C989M, Grade 100 or 120.

2.4.1.4 Water

Water must be fresh, clean, and potable.

2.4.1.5 Aggregates

ASTM C330/C330M or ASTM C33/C33M, Size 8 (3/8 inch), except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates must not contain any substance which may be deleteriously reactive with the alkalis in the cement. Coarse aggregate size designation must be 1/2 inch maximum. Lightweight aggregate must consist of expanded and coated shale or equivalent material of sufficient strength and durability to provide concrete of the required strength.

2.4.1.6 Admixtures

2.4.1.6.1 Air-Entraining

ASTM C260/C260M.

2.4.1.6.2 Accelerating

ASTM C494/C494M, Type C or E.

2.4.1.6.3 Water Reducing

ASTM C494/C494M, Type A, E, or F.

2.4.1.6.4 Corrosion Inhibitor

Calcium nitrite, Type C ASTM G109 and ASTM C494/C494M. Add at the rate recommended by the Manufacturer for the service life of the dock, but not less than 2 gallons per cubic yard.

2.4.2 Grout

2.4.2.1 Nonshrink Grout

ASTM C1107/C1107M.

2.4.2.2 Cementitious Grout

Must be a mixture of portland cement, sand, and water with a minimum compressive strength of 5000 psi at 28 days. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

2.4.3 Reinforcement

2.4.3.1 Reinforcing Bars

ASTM A615/A615M or ASTM A706/A706M, Grade 60. All bar reinforcement must be galvanized in accordance with ASTM A767/A767M. Wires used to tie the reinforcement must be plastic coated, or galvanized.

2.4.3.2 Welded Wire Reinforcement

ASTM A1064/A1064M or ASTM A1022/A1022M; ASTM A276/A276M for stainless steel bars. Provide flat sheets of welded wire fabric, rolled fabric is not acceptable.

Galvanize in accordance with ASTM A153/A153M

2.4.4 Metal Accessories

All carbon steel metal accessories must be hot dipped galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M. Repair damaged hot dipped galvanized coating in accordance with ASTM A780/A780M. All stainless steel metal accessories must be in accordance with ASTM F593, Group 2 and ASTM A276/A276M, Type 316L.

2.4.4.1 Structural Steel

Structural steel must be ASTM A36/A36M, ASTM A572/A572M. ASTM A992/A992M Grade 50 and be minimum 1/4 inch thick. Stainless steel structural shapes must be ASTM A276/A276M, Type 316L.

2.4.4.2 Embedments

Embedments in dock must be ASTM F593 Group 2 stainless steel with welded loop or horizontal bar hook.

2.4.4.3 Bolts

Carbon steel bolts must be ASTM A307 or ASTM A449 for high strength bolts. Stainless steel bolts must be ASTM F593, Group 2. All bolts must be a minimum diameter of 1/2 inch.

2.4.4.4 Nuts

ASTM A563/ASTM A563M or ASTM F594, Group 2.

2.4.4.5 Washers

ASTM F844, ASTM F436/F436M, or Type 316 stainless steel. Washers must be used with all nuts and bolts. Use round plate washers for bearing on wood and cut washers for bearing on steel. Use beveled washers where bearing surfaces have a slope greater than 20:1 with respect to a plane normal to the bolt axis.

2.4.4.6 Dissimilar Metals

Where dissimilar metals are in contact, the surfaces must be protected with a coat of bituminous paint or separated by an isolation material to prevent galvanic action.

2.4.5 Foam Core

Foam core floats must be a rigid block of closed cell expanded polystyrene (EPS). Properties of the foam must conform to ASTM C578 with maximum water absorption less than 4 percent as determined by ASTM C272/C272M, method C. The EPS foam must have a unit weight between 0.90 - 1.20 pcf. Core must not contain more than 10 percent reground EPS foam material. Reground foam pieces must not exceed 3/8 inch diameter.

2.4.6 PVC Sleeves

PVC pipe must be ASTM D2241 thin wall Class 200, SDR 21, embedded as required for all thru-rods and utility raceways.

2.4.7 Utility Raceways

Pull boxes for electrical raceways must conform to State or local electrical codes, must be set flush with the walking surface, and self-draining. All bolts for lids on pull boxes must be ASTM F593, Group 2, 316 stainless steel. Boxes must have a 1 inch nominal concrete bottom.

2.4.8 Dock Accessories

2.4.8.1 Cleats

Dock cleats must be cast steel or ductile iron, hot dipped galvanized open base cleats with size and spacing as indicated on the Drawings minimum 18 inches. Attach cleats to the dock structure based on Manufacturers' recommendations.

2.4.8.2 Dock Fenders

Dock fenders must be continuous minimum 3 inch non-marking D-type fenders black in color, non-marking. The dock fender must be applied to the exposed edges and corners of all docks.

2.4.8.3 Ladders

Safety ladders must be ASTM A276/A276M 316L Stainless Steel, designed in accordance with OSHA standards.

2.4.8.4 Guide Pile Rub Blocks and Rollers

Rub blocks or rollers must be black UHMW polyethylene conforming to ASTM D4020 2 inches thick minimum. Blocks or rollers must be secured with

Type 316/316L stainless steel fasteners. Fasteners must be counter bored to prevent fastener contact with the pile surface. Allow for a minimum block wear of 1 inch without damage to the pile coating or rubbing surface. Top and bottom edges of the block facing the guide pile must be rounded to 3/4 inch radius.

Rub blocks rollers must be adjustable to accommodate Guide Pile installation tolerances; clearance between each Rub block/roller and the pile must be adjusted to 1 inch maximum and 1/2 inch minimum under "no load" condition. Fixed blocks that bind within the guide are prohibited.

2.5 GANGWAY MATERIALS

2.5.1 Aluminum

Aluminum alloy must be 6061-T6. Extruded in accordance with the applicable requirements of SAE AMS-QQ-A-200/8 and ASTM B221. Aluminum welding must in accordance with AWS D1.2/D1.2M.

2.5.2 Fasteners

- a. ASTM F593, Group 2 316L stainless steel bolts.
- b. ASME B18.21.1 Type 316L stainless steel washer, or 1/4 inch thick Type 316L plate washer.
- c. ASTM F593 Group 2 316L austenitic stainless steel nuts.

2.5.3 Castings

F-214 Cast aluminum. Castings must be true to pattern, structurally sound and free from blow holes or other defects.

2.5.4 Insulators

MIL-I-24768/14. Bushings or separation sheets must be a minimum of 1/16 in thickness.

2.5.5 Wheels

CID A-A-55619, UHMW polyurethane, with UV inhibitors added. Color must be black.

2.6 RECEPTACLE STATIONS

Receptacle stations must include enclosure, mechanical interlocks, and related wiring and devices as indicated.

2.6.1 Enclosure

Enclosure must be NEMA ICS 6, type 3R, fabricated of 16 gauge 316L Aluminum. Paint ASTM D1535 light gray No. 61. Paint coating system must comply with IEEE C57.12.29.

2.6.2 Mechanical Interlocks

UL 231, UL 1686, UL 98. Mechanical interlock devices must incorporate a fused disconnect safety switch and IEC receptacle in a non-metallic, watertight, enclosure. The interlock mechanism must prevent making and

breaking of power under load. Enclosure must be rated NEMA 4X and also rated IP67 in accordance with IEC 60529. Include matching plug for each mechanical interlock provided. Plugs and receptacles must be classified to IEC 60309-1 and IEC 60309-2.

2.6.3 Circuit Breakers

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated.

2.6.4 Ground-Fault Circuit Interrupter Receptacles for Personnel Protection

UL 943, duplex type for mounting in standard outlet box. Device must be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFI devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads. Provide in nonmetallic box with gasketed, weatherproof, nonmetallic cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle must be UL listed for use in "wet locations with plug in use."

2.7 ALL-PURPOSE PEDESTALS

A complete factory-assembled and prewired unit specifically constructed for marina applications. All-purpose pedestal must be a two shore power receptacle pedestal mounted type having a separate circuit breaker for each receptacle. Circuit breaker size must be the same size as receptacle to which it is connected. Shore power outlets must have individual Ground-Fault Protection Equipment (GFPE) set to open at currents not exceeding 30 milliamperes. Power outlets must be single, locking and grounding type, size and voltage as indicated. Pedestal enclosure must be aluminum with a white powder coated finish. Receptacles must be housed in weatherproof cover. Entire exterior surface of pedestal must be designed for exposure to saltwater environment. Provide photo cell controlled 3-10 watt LED station light with amber lens.

2.7.1 Warning Sign

Provide permanently mounted waterproof warning sign at each pedestal. Sign must have red letters on a white background with letters no less than 1/4 inch in height. Sign must be worded as follows:

WARNING

To minimize shock hazard and fire hazards, connect and disconnect cables as follows:

- 1. Turn off the boat's shore connection switch before connecting or disconnecting shore cable.**
- 2. Connect shore power cable at the boat first.**
- 3. Disconnect shore power cable at shore outlet first. Close shore power cover tightly.**

DO NOT ALTER SHORE POWER CABLE CONNECTORS

2.8 POTABLE WATER SYSTEM

The potable water system consists of the necessary piping and fittings to distribute water to all water connections throughout the dock system.

2.8.1 Piping

Potable water piping in the floating dock system must be in accordance with Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING. All materials must be weatherproof and suitable for a corrosive marine environment. Defection at the floating dock system must be considered in the piping material selection. Piping must be equipped with means to properly drain and winterize all exposed sections.

2.8.2 Flexible Connections

Flexible connections suitable for potable water must be used at the dock-to-shore interface. Location specific water level conditions must be considered in the selection of flexible connections to be used.

2.8.3 Potable Water Hose Connection

Potable water service provided by 2 hose bibb(s) at each all-purpose pedestal. Hose bibb(s) must be lead free and suitable for potable water use. Hose bibb(s) must be equipped with anti-siphon device.

PART 3 EXECUTION

3.1 FLOAT FABRICATION

PCI MNL-116 unless specified otherwise.

Before handling concrete materials, all handling equipment and forms must be thoroughly cleaned of concrete splashing, dirt, debris and other foreign matter and forms must be coated as specified. The QC designated person, and only one as approved by the Contracting Officer, must be designated to be responsible for maintaining consistent, uniform concrete.

3.1.1 Precast Floats

Precast floats must be cast monolithically, cold joints of any type are not acceptable. Floats must have a minimum deck and wall thickness of 2 inches. Precast float decks must be constructed to drain freely and there must be no floodable enclosed spaces. Precast floats must meet the fabrication tolerances specified in Part 3 in paragraph entitled "DOCK SYSTEM TOLERANCES".

3.1.2 Forms

Brace forms of sufficient strength and rigidity to prevent deformation and maintain the intended size and shape during the casting process. Forms must produce a smooth, dense surface. Forms must be so constructed and braced that all principal planes will be either true horizontal or true vertical. Chamfer exposed edges of floats 1/2 inch, unless otherwise indicated. Form tolerance must not exceed 1/8 inch dimensions indicated on shop drawings. When measured diagonally, floats more than 1/2 inch out of square must be rejected.

Forms must be so constructed that floats can be cast without construction

joints. Forms must be thoroughly cleaned after each use and coated with oil, paraffin, or other applications, as may be necessary to prevent bonding of the concrete and to leave clean, smooth and hard surfaces. Forms may be stripped once the design strength has been achieved as required by the design calculations, provided the concrete is not injured.

The foam core must be pre-formed to the interior configuration as a solid block with an allowable variation of 1/8 inch from the dimensions shown on the shop drawings. The use of cores formed by joining small blocks of foam together is not permitted unless the material and method for joining such blocks has been approved by the Contracting Officer. Cores must be securely anchored in place during the casting of concrete. Displacement that results in loss of minimum concrete cover over reinforcement of 1 inch or less than 1 1/2 inches wall thickness or less than 2 inches deck thickness must be cause for rejection.

Floats must be thoroughly cleaned of excess oil, paraffin, or other form release applications prior to delivery to the work site; floats must not remain in the water at the work site if they produce any visible discharge of petroleum based products. Removed floats must be cleaned off site by the Contractor, who must also bear all costs associated with cleanup of the discharge. Embedments, through-rod tubes, and electrical raceways must be placed true to location shown in the shop drawings with a tolerance of +/- 1/8 inch and must not exhibit a deflection greater than 1/4 inch in any direction.

3.1.3 Reinforcement Placement

ACI 318 and ACI 301 for reinforcement placement and splicing. Reinforcement may be preassembled before placement in forms.

3.1.4 Concrete Mixing

ASTM C94/C94M. Mixing operations must produce batch-to-batch uniformity of strength, consistency, and appearance. Size of batches must be so controlled that concrete is placed in forms within one hour after materials have been placed in the mixer. All casting must be performed under cover or in fair weather conditions and the casting area must be screened from sun, wind and other elements immediately following concrete placement. Concrete must be conveyed from the mixer and deposited in its final position in a manner to prevent separation and segregation of materials. Flowing must be avoided as it causes segregation.

3.1.5 Concrete Placing

ACI 304R, ACI 305.1 for hot weather concreting, ACI 306.1 for cold weather concreting, and ACI 309R, unless otherwise specified. Concrete must be vibrated internally and/or externally to assure a smooth, dense finish. Floats must be cast monolithically, and the placing of concrete must be a continuous operation from the start to the completion of a float. The plasticized concrete must be thoroughly compacted with a powered vibrator to fill all form cavities and fully surround all reinforcement and embedments.

3.1.6 Concrete Curing

ACI 308.1. Commence curing immediately following the initial set and completion of surface finishing in accordance with ACI 308.1. Provide curing procedures to keep the temperature of the concrete between 50 and

165 degrees F. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts. Cure for a minimum of seven days prior to transporting, launching and assembly.

Floats must be cured for a minimum period of 7 days before transporting or assembling unless otherwise approved by the Contracting Officer. Curing may be accomplished by any of the following methods:

- a. Spraying with curing compound as soon as exposed surfaces are firmly set and as soon as forms are removed from formed surfaces.
- b. Covering with burlap or other suitable material and keeping constantly wet.
- c. Immersing in water.

The Contractor must select the method of curing and be responsible for the result, except that all curing must be with complete protection from sun, wind, and freezing temperatures.

3.1.7 Surface Finish

Precast floats containing hairline cracks which are visible and are less than 0.02 inches in width may be accepted. Cracks larger than 0.005 inch width for surfaces exposed to the weather must be repaired. Precast floats which contain cracks exceeding these limits must be approved by the Contracting Officer, prior to being repaired. Any precast float that is structurally impaired or contains honeycombed section or voids deep enough to expose reinforcing may be rejected. Voids up to 1/2 inch diameter and 1/8 inch depth must be patched with an approved grout. Larger voids may only be repaired with the approval of the Contracting Officer.

3.1.7.1 Unformed Surfaces

Provide a steel troweled and broomed finish for dock deck surface. Slip resistant broomed deck finish must be transverse to dock orientation. All deck edges must have a minimum 3/8 inch tooled radius with a minimum 1 1/2 inch wide, smooth, hard steel finished face. All surfaces to receive contacting timber must be smooth and true to within 1/32 inch.

3.1.7.2 Formed Surfaces

PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes. Provide a standard grade surface finish for both exposed and unexposed areas.

3.1.8 Float Identification

Each precast float must be permanently marked on one side and one end, between the bottom of the waler and the waterline in an accessible location. Identification must include name of Manufacturer, date of manufacture, specific float type, casting date, and job number using a stamp or stencil of a type and design approved by the Contracting Officer. Such information must be imprinted on the concrete at the plant and not be altered thereafter.

3.2 OPERATION AND MAINTENANCE MANUAL

Submit a project specific operation and maintenance manual for the floating dock system prior to completion of the project. Provide manual in electronic PDF file format and bound, hard copy format with manual titled "Floating Dock System Operation and Maintenance Manual". Manual must include the following as a minimum:

- a. Recommendations for operating floating dock system such as sizing and tying-up vessels consistent with the designer's assumptions and highlighting the limitations on berth occupancy to prevent overloading the dock system.
- b. Recommendations for preventive maintenance, maintenance procedures, and materials by brand name and specification.
- c. Manufacturer's O&M information required by the paragraph, SD-10, OPERATION AND MAINTENANCE DATA.
- d. Catalog data required by the paragraph, SD-03, PRODUCT DATA.
- e. Final approved shop drawings required by the paragraph SD-02, SHOP DRAWINGS.
- f. Prices for spare parts and supply list.

3.3 INSTALLATION

Installation of dock system must be in accordance with approved shop drawings with connections tightened as required after complete installation of each unit of the work in the water and before final inspection. Walers, fascia, spacers, panels, or any other members, which are subject to foot traffic, must be flush with the concrete walking surface.

3.3.1 Bolted Connections

Provide anchorage for fastening work in place. Conceal fasteners where practicable. Fasteners must not protrude beyond the fascia into the berthing area. Fasteners protruding above the surface of the deck must have a low, rounded profile.

Bolts must be of the size required, with adequate thread length. Make threaded connections up tight and nick threads to prevent loosening. Holes for all lag bolts and screws must be pre-drilled and turned into place. Driving through timbers is not allowed.

3.3.2 Welding

AWS D1.4/D1.4M and AWS D1.2/D1.2M. All welding must be performed under the supervision of certified welders. Protect the concrete and other reinforcing from heat during welding. Weld continuously along the entire area of contact. Grind smooth visible welds in the finished installation. Welding of epoxy-coated reinforcing is not permitted.

3.4 SURFACE REPAIR

Prior to erection, and again after installation, precast floats must be checked for damage, such as cracking, spalling, and honeycombing. Precast

floats that do not meet the surface finish requirements specified in Part 2 in paragraph entitled "Surface Finish" must be either repaired or removed and replaced with new precast floats as directed by the Contracting Officer.

3.5 LAUNCH AND ASSEMBLY

Precast floats must attain the specified concrete strength prior to launching, unless otherwise approved by the Contracting Officer. Assemble in accordance with the approved shop drawings. Brace precast floats, unless design calculations submitted with the shop drawings indicate bracing is not required.

3.6 OPENINGS

Holes or cuts in the dock floats, which are not indicated on the approved shop drawing, must only be made with the approval of the Contracting Officer. Drill holes less than 12 inches in diameter with a diamond tipped core drill.

3.7 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanized surfaces damaged by handling, transporting, cutting, welding, bolting, or acid washing. Do not heat surfaces to which repair paint has been applied.

3.8 GROUTING

Clean and fill indicated areas solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

3.9 SEALANTS

Provide where indicated or as specified in Contract drawings.

3.10 DOCK SYSTEM TOLERANCES

Install floating dock system to the planned dimensions within the tolerances specified herein. Any float exceeding the allowable fabrication and installation tolerances must be removed and replaced.

3.10.1 Float Fabrication Tolerances

Float Fabrication Tolerances (allowable deviation of construction dimension from nominal dimension shown on the Drawings):

- a. Float Width: +/- 3 inches from nominal float width.
- b. Float Depth: +/- 1 inch design depth as required to satisfy freeboard requirements.

3.10.2 Float Installation Tolerances

The dock system must be installed within 3 inches of the design position. The dock system must not move more than 4 inches laterally from the design position in any direction when operational lateral loads are applied.

3.10.2.1 Dock Freeboard

Dock freeboard must be within +/- 1 inch of specified freeboard. Dock freeboard that is less than specified may be corrected by placing supplemental flotation under the dock only with the approval of the Contracting Officer. Supplemental floats must consist of expanded polystyrene foam core fully encapsulated in polyurea coating or polyethylene shells, 0.15 inches minimum thickness, designed for complete submersion in water with no vents or air valves. The floats must adhere to dock using high strength, water activated glue or interlock with the dock to prevent lateral displacement without the use of steel fasteners.

-- End of Section --

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RUBBER MARINE FENDERS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.21.1 (2009; R 2016) Washers: Helical
Spring-Lock, Tooth Lock, and Plain Washers
(Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A479/A479M (2021) Standard Specification for
Stainless Steel Bars and Shapes for Use in
Boilers and Other Pressure Vessels

ASTM D395 (2016; E 2017) Standard Test Methods for
Rubber Property - Compression Set

ASTM D412 (2016) Standard Test Methods for
Vulcanized Rubber and Thermoplastic
Elastomers - Tension

ASTM D471 (2016a) Standard Test Method for Rubber
Property - Effect of Liquids

ASTM D573 (2004; R 2019) Standard Test Method for
Rubber - Deterioration in an Air Oven

ASTM D575 (1991; R 2012) Rubber Properties in
Compression

ASTM D624 (2000; R 2020) Standard Test Method for
Tear Strength of Conventional Vulcanized
Rubber and Thermoplastic Elastomers

ASTM D746 (2014) Standard Test Method for
Brittleness Temperature of Plastics and
Elastomers by Impact

ASTM D1171 (2018) Standard Test Method for Rubber
Deterioration - Surface Ozone Cracking
Outdoors (Triangular Specimens)

ASTM D2000 (2018) Standard Classification System for
Rubber Products in Automotive Applications

ASTM D5363 (2016) Standard Specification for
Anaerobic Single-Component Adhesive (AN)

ASTM F593	(2017) Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	(2009; R 2020) Standard Specification for Stainless Steel Nuts

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Arch Fender

Hardware

Unit Fender

SD-05 Design Data

Reaction--energy--percent compression curve

Dimension

Arch Fender and Unit Fender material specifications

Design calculations

SD-06 Test Reports

Minimum Tensile Strength

Shore Hardness (Durometer)

Modulus at 400 Percent Elongation

Maximum Compression Set

Tear Resistance

Minimum Elongation

Ozone Resistance

Low Temperature Impact Resistance

Water Absorption

Heat Resistance

Compression Deflection Resistance

Fender Compression Test

SD-08 Manufacturer's Instructions

Installation Instructions

1.3 DELIVERY HANDLING AND STORAGE

Fenders shall be undamaged when delivered and shall be handled and stored so as to prevent damage, such as bending or abrading end fittings, cutting of rubber, or damage to coating of hardware. Protect fenders from exposure to damaging liquids, oils, greases and extended exposure to sunlight.

PART 2 PRODUCTS

2.1 CONFIGURATION

Arch Fender shall be extruded and shall be continuous in the length indicated. The fenders shall have a truncated "A" cross section shape and be attached to the structure at the base, the widest dimension, of the arch. The connecting hardware shall be fully exposed. No encased hardware or molded fenders shall be allowed. The fender and hardware shall be designed and factory tested to the loads per linear foot of fender specified in paragraph entitled "PERFORMANCE," for angles of approach of 0 and 15 degrees. Fender anchor bolts and method of anchorage shall be of the size and spacing required by the manufacturer's design and testing; however, the size and spacing of anchor bolts indicated on the drawings shall be construed to be the minimum required, unless exceeded by the requirements of the fender manufacturer's design.

Unit Fender shall be extruded and shall be continuous in the length indicated. The fenders shall have a trapezoidal cross section. The modular units are compression molded from a high performance polymer. The connecting hardware shall be fully exposed. No encased hardware or molded fenders shall be allowed. The fender and hardware shall be designed and factory tested to the loads per linear foot of fender specified in paragraph entitled "PERFORMANCE," for angles of approach of 0 and 15 degrees. Fender anchor bolts and method of anchorage shall be of the size and spacing required by the manufacturer's design and testing; however, the size and spacing of anchor bolts indicated on the drawings shall be construed to be the minimum required, unless exceeded by the requirements of the fender manufacturer's design.

2.2 ELASTOMER

The elastomer shall be the ethylene propylene dimonomer (EPDM), as specified in ASTM D2000 or Contracting Officer approved material(s), with the following properties:

<u>ELASTOMER PROPERTY REQUIREMENTS</u>	
Minimum Tensile Strength (ASTM D412)	2000 psi
Shore Hardness (Durometer) (ASTM D412)	70 <u>plus</u> 5

<u>ELASTOMER PROPERTY REQUIREMENTS</u>	
Modulus at 400 Percent Elongation (ASTM D412)	900 psi
Maximum Compression Set (ASTM D395 Method B, Maximum Percent 22 Hr. at 158 Degrees F)	25 Percent
Tear Resistance (ASTM D624; DIE B Min. 150 lb/in)	300 lb/in.
Minimum Elongation (ASTM D412)	500 Percent
Ozone Resistance (ASTM D1171 Exposure Method B; 70h Bent Loop at 100 Degrees F; 50pphm)	80 H <u>plus</u>
Low Temperature Impact Resistance (ASTM D746 Procedure B; Non-Brittle at minus 67 Degrees F)	minus 40 Degrees F
Water Absorption (ASTM D471 Method B; 70h 212 Degrees F; Volume Change <u>plus</u> 5 Percent)	10.0 Percent
Heat Resistance (ASTM D573; 70h at 212 Degrees F Ch Tensile, Elong. minus 25 Percent, Hardness plus 10)	Shall exceed requirements
Compression Deflection Resistance (ASTM D575 Method B; 3 S Dwell at 73 Degrees F)	Shall exceed requirements

2.3 HARDWARE

2.3.1 Plates and Angles

ASTM A479/A479M, Type 316L stainless steel for plates, angles, and miscellaneous hardware required to attach the fenders to the structure.

2.3.2 Nuts, Bolts, and Washers

ASTM F593 or ASTM F594, Group 2 (316 alloy) stainless steel for nuts and bolts. ASME B18.21.1 for washers, except fabricate washers of 316 alloy stainless steel. Provide thread locking compound or jamb nuts to prevent loss of all fasteners.

2.3.3 Antiseize Compound

Not Used, use Tread Lock Compound or Double Nuts for fender elements.

2.4 PERFORMANCE

When vertically compressed by a plate extending the full length and width of a 1.0 meter section of the fender, the arch fender must absorb at least 59.5 kNm of energy minus 10 percent when 54 percent compressed (i.e., to a dimension of 46 percent of its original height) with a corresponding load of not more than 354 kN plus 10 percent.

When vertically compressed by a plate extending the full length and width of a 1.0 meter section of the fender, the unit fender must absorb at least 69.6 kNm of energy minus 10 percent when 57.5 percent compressed (i.e., to a dimension of 42.5 percent of its original height) with a corresponding load of not more than 414 kN plus 10 percent.

2.4.1 FENDER COMPRESSION TEST

Compress fender along its longitudinal axis between two parallel flat plate surfaces to a compressed dimension of 54 percent of its original height. Record load and the corresponding deflection at 1/4 inch increments and plot as a graph of load versus deflection. The Load-Deflection curve shall then be integrated to generate an Energy-Deflection curve for the fender. After compression of the fender to 54 or 57.5 percent of its original height, the fender shall be rebound to 98 percent of its original height within ten minutes after the load is removed.

PART 3 EXECUTION

3.1 INSTALLATION

Install fenders with the fender longitudinal axis vertical. Install the fenders in the position and at the spacing indicated on the drawings.

3.1.1 Thread Lock Compound

Coat threads of bolts prior to applying washers and nuts. Recoat bolt thread projection beyond nut after tightening. Provide Jamb Nuts or medium strength (removable) thread locking compound to prevent loss of fasteners, such as LocTite 242 (blue, aka MIL-S_46163A Type II, Grade N, ASTM D5363, Group 3, Class 2, Grade 1)

-- End of Section --

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SECTION 35 59 20

HDPE PIPE PILE SLEEVES

06/19

PART 1 GENERAL

1.1 SUMMARY OF WORK

The work under this section consists of fabrication and installation of grout-filled HDPE protective sleeves at the top of all steel pipe piles installed for the NOAA OMAO SHIP & SUPPORT FACILITY RELOCATION project at Naval Base Newport in Newport, RI. The Contractor must furnish all materials, labor, equipment, utilities, and incidental items necessary for the installation of HDPE pipe pile sleeves as indicated on the project drawings and specified herein. The cementitious grout filled pile jackets form a 4-hour fire rated assembly per NFPA 307 Section 4.2.4.1.1 with a 2-inch annulus per IBC Table 721.1(1) Item No. 1-1.6

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C109/C109M	(2021) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C882/C882M	(2020) Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C1090/C1090M	(2015) Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
ASTM D1238	(2013) Melt Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D1505	(2018) Standard Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D1525	(2017) Standard Test Method for Vicat Softening Temperature of Plastics
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D2837	(2013) Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
ASTM D3350	(2021) Polyethylene Plastics Pipe and Fittings Materials

ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D746	(2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM F1473	(2013) Standard Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installation Plan; G

SD-02 Shop Drawings

HDPE Sleeves; G

SD-03 Product Data

HDPE Sleeves; G

Include dimensions, material specifications, and method of manufacture.

Underwater High-Strength Grout; G

SD-06 Test Reports

Results of the Test Pile Sleeve Installation; G

Underwater High-Strength Grout; G

SD-11 Closeout Submittals

Inspection Report

1.4 QUALITY ASSURANCE

1.4.1 Installation Plan

Develop and submit for approval a plan detailing the general means, methods, procedures, and techniques to be employed for installation of the HDPE sleeves. The plan must include, but not be limited to:

- a. Details for temporary bracing/support during placing and curing of grout, including stay-in-place formwork at the bottom of the HDPE Sleeve.
- b. Details of grout injection ports or other access points for placement of grout and methods of permanent closure, or description of tremie placement
- c. Pile cleaning procedures prior to HDPE sleeve placement.
- d. Installation procedures for the HDPE sleeves and grout fill

1.5 DELIVERY AND STORAGE

Handling and storage of HDPE sleeve materials shall strictly conform to the manufacturer's recommendations.

1.5.1 HDPE Pipe Sleeves

HDPE pipe sleeves shall be shipped in closed containers or covered with tarpaulins to prevent contamination by dirt or road films. HDPE pipe sleeves shall be properly stored at the jobsite to minimize distortion and to prevent contamination by foot traffic and blown debris. If storage at project is to exceed 30 days, shaded storage shall be provided.

PART 2 PRODUCTS

2.1 HDPE SLEEVES

The top of driven steel pipe piles and stay-in-place steel pipe casing at the must be protected by a high density polyethylene (HDPE) sleeve. Height and thickness of the HDPE sleeve shall be as indicated on the plans. The HDPE sleeve shall have the following minimum physical properties:

<u>Physical Properties of HDPE Material</u>		
Property	Test Procedure	Value
Density	ASTM D1505	0.955 (black) gms/cm3
Melt Index	ASTM D1238	0.08 gms/10 minutes
Hydrostatic Design Basis	ASTM D2837	1600 psi @ 73 deg. F
Color: UV Stabilizer	ASTM D3350	2-3% Carbon Black

<u>Physical Properties of HDPE Material</u>		
Property	Test Procedure	Value
Flexural Modulus 2% Secant - 16:1 span:depth 0.5 in./min	ASTM D790	>110,000 psi
Tensile Strength at Yield	ASTM D638	3,200 psi
Elongation at Break	ASTM D638	>700%
Elastic Modulus	ASTM D638	>150,000 psi
Hardness	ASTM D2240	62 (Shore D)
PENT	ASTM F1473	>100 hours
Vicant Softening Temperature	ASTM D1525	256 deg. F
Brittleness Temperature	ASTM D746	-103 deg. F
Thermal Expansion	ASTM D696	1.0 x 10 ⁻⁴ in./in./deg. F

2.1.1 Injection Ports

The sleeves shall be equipped with minimum one inch diameter injection ports spaced at intervals not to exceed 4 feet. To provide even distribution of grout, the injection ports shall be placed on alternate sides. The bottom injection port shall be spaced 6 inches from the bottom of the sleeve and the top injection port shall be spaced 6 inches from the top of the sleeve. The injection ports shall be fitted into the sleeve wall prior to installation, except in special situations, approved by the Contracting Officer, where a port may be added to accommodate an unanticipated jobsite condition.

2.2 UNDERWATER HIGH-STRENGTH GROUT

The annulus between the steel pipe pile and HDPE sleeve shall be grouted using an underwater pump grade, cement based, non-shrink grout. The grout shall be proportioned to meet the handling, placement, and pumping requirements of the intended application, and the design mix shall be submitted for approval. Viscosity of the mixed grout shall be such that it may be pumped without segregation between the sleeve and pile wall without the formation of voids. The grout shall have the following minimum physical properties:

<u>Physical Properties of Underwater High-Strength Grout Material</u>		
Property	Test Procedure	Value
Compressive Strength, minimum	ASTM C109/C109M	8,000 psi @ 28 days
Bond Strength, minimum	ASTM C882/C882M	2,000 psi @ 28 days

<u>Physical Properties of Underwater High-Strength Grout Material</u>		
Property	Test Procedure	Value
Hardened Height Change	ASTM C1090/C1090M	0.0% to 0.3%

2.3 EQUIPMENT

The grout to be injected into the sleeves shall be proportioned, mixed, and pumped with equipment expressly designed for that purpose.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Surface Preparation

Where the sleeve will be bonded to the pipe pile, marine growth, oil, grease, mud, rust, micro-organisms, and any other deleterious material which might prevent proper bonding between the grout and the pile shall be removed to expose either the pile coating or bare steel. Pressure wash steel pipe pile to remove marine growth along the length of the proposed HDPE sleeve not more than 72 hours prior to grouting of the sleeve.

3.1.2 HDPE Sleeve Preparation

HDPE sleeve positioning around the pile shall be performed by the Contractor in such a manner as to assure that no damage to centering devices occurs and that there will be no detrimental movement of the sleeve while grout is curing.

The sleeve shall be supported by temporary bracing or other means supplied by the Contractor to assure that it will not move or distort during the grout placement and curing period. Seal the bottom of HDPE sleeve using structural concrete underwater hand pack material or other acceptable means to retain the grout to be placed in the annulus between the pile and the sleeve. The bottom seal shall be fully cured before proceeding to the next step.

3.1.3 Grout Placement

Grout shall be placed as recommended by the manufacturer. Grout shall be injected at equal pressures, into the lower ports at the bottom of the HDPE sleeve. Grout shall be continuously injected until the grout reaches the top injection port.

At the Contractor's option, he may install multiple levels of grout ports to minimize the pumping pressures. In this instance, injection shall begin at the bottom level of the injection ports. As the grout appears at the next higher port level, and it has been determined that the space between the pile and the sleeve is filled to that level, the lower ports shall be capped off and the injection begun at the next higher port level where the grout appeared. This process is repeated from port level to port level until the grout reaches the top of the sleeve.

At the Contractor's option, he may inject a short lift of grout (6 inches to 12 inches in height) into the bottom-most port and allow it to cure

before proceeding with subsequent lifts. If this practice is used, the sleeve shall be fitted with an additional level of injection ports to coincide with the top of the first lift.

The injection process shall be continuous, except for brief interruptions when the injector is moved from port to port, and the speed of the injection process shall be controlled to prevent entrapment of water or air in the grout cavity being filled. After the grout has cured, the ports shall be removed and ground flush with the surface of the sleeve.

3.1.4 Completion

After the grouting process is completed and the grout has sufficiently cured, all temporary support for the sleeve shall be removed.

Any gap between the top of the sleeve and the bottom of the pile caps shall be filled with a trowel grade epoxy.

3.2 TEST PILE SLEEVE INSTALLATION

Prior to fabrication and installation of any production HDPE pile sleeves, the Contractor shall prepare and carry out a full scale onshore (or on-barge) mock up of a 10 foot high pile section as a test bed for the proposed pile sleeve installation procedure. The pile sleeve test installation shall be carried out using an 8 foot high pile sleeve, fabricated with the same grout port sizes and locations intended for use on the production piles. The test installation shall also utilize the same grout mix and pumping equipment intended for the production installations. The full scale test shall be carried out in the presence of the Contracting Officer, and shall demonstrate the ability of the proposed grout port sizes and arrangements, pumping equipment, grout mix and form seals for their intended use.

Twenty-four hours after the grouting operation for the test sleeve is completed, in the presence of the Contracting Officer, the Contractor shall saw cut six equally spaced vertical joints in the HDPE sleeve to remove the sections of sleeve and inspect the grout for compliance with the requirement that there be no air bubbles or voids between the sleeve and pile wall.

Should air pockets or voids be found to exist, the test shall be deemed to have failed, and the Contractor, at no additional cost to the Government, shall repeat the test as many times as necessary, with variable adjustments to the grout port size and locations, grout mix, and/or pumping equipment until satisfactory results are obtained.

A satisfactory test result, approved by the Contracting Officer, shall be required prior to ordering of production sleeves or installation of the pile sleeves on the production piles.

The results of the test pile sleeve installation shall be documented in a report to the Contracting Officer. The report shall include the final arrangement of the lower grout seal and centering devices, the grout mix, the grout port sizes and locations, the pumping equipment, and the installation procedures to be followed for the production pile sleeves.

3.3 INSTALLATION AND INSPECTION

Perform an independent dive inspection of all pile sleeves to verify

compliance with installation procedures for installing the HDPE sleeves and grout fill, and project specifications. Submit inspection report.

-- End of Section --

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SECTION 35 59 35

MOORING FITTINGS

06/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A449	(2014; R 2020) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A572/A572M	(2021; E 2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C827/C827M	(2016) Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F436	(2011) Hardened Steel Washers

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3

(2007) Commercial Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication and Installation Drawings

Submit templates, fabrication and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the construction.

Bolts, Nuts, and Washers, fabrication and installation drawings; G

Mooring Bollards, fabrication and installation drawings; G

SD-03 Product Data

Paint System; G

Marine Grade Silicone Sealant (for filling anchor rod recesses); G

Nonshrink Grout; G

SD-05 Design Data

Mooring Bollard Design Calculations; G

Submit detailed design calculations demonstrating proposed double bitt mooring bollard and hardware meets the loading requirements with the required factor of safety as indicated herein. Calculations shall be stamped by a registered Professional Engineer.

SD-06 Test Reports

Bolts, Nuts, and Washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Qualifications; G

Mooring Bollards; G

Bolts, Nuts, and Washers; G

Paint System; G

Non-Shrink Grout; G

Galvanizing; G

The mooring fittings manufacturer shall provide all required material test certificates and certificates of conformance upon delivery to the project site.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

Manufacturer of mooring bollards shall provide a supply list demonstrating that it has been in the business of manufacturing similar bollard systems for at least 5 years and show proof of 10 installations (including project names and locations) within the United States, each having been in service for at least 3 years.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items free from contact with soil and weather. Remove and replace damaged items with new items.

1.5 AMBIENT CONDITIONS

Begin mooring bollard painting system application only when ambient and curing temperatures are within limits of coating manufacturer's recommendations and at least 5 degrees F above dew point temperature.

Do not clean or paint mooring bollard when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Mooring fittings shall be new ductile cast iron bollards as indicated on the drawings. Submit detailed mooring bollard design calculations demonstrating proposed mooring fittings and hardware meets the loading requirements with the required factor of safety as indicated herein. Calculations shall be stamped by a registered Professional Engineer.

2.1.1 Design Criteria

Mooring fitting material shall be stress-relieved cast steel conforming to ASTM A536, Grade 65-45-12. Minimum capacity of the mooring bollards and cleats shall be as indicated. Mooring bollards shall be shop primed. Provide fastening hardware compatible with the capacity, materials and the fittings as indicated on the drawings and as specified herein.

2.2 MATERIALS

2.2.1 Mooring Fittings

2.2.1.1 Mooring Bollards

ASTM A536, Grade 65-35-12. Size, dimensions, and details of fabrication as indicated.

2.2.2 Structural Steel

ASTM A36/A36M or ASTM A572/A572M.

2.2.3 Bolts, Nuts, and Washers

The mooring fittings shall be anchored to the concrete structure as indicated with bolts conforming to ASTM A449 or ASTM F1554, Grade 105. Nuts shall be heavy hex conforming to ASTM A563, Grade DH and washers shall conform to ASTM F436. All anchorage hardware shall be hot-dipped galvanized and supplied by the bollard manufacturer to ensure proper fit.

2.2.3.1 Steel Plate Washers

Steel plate washers to be utilized at bollard anchor bolt locations shall conform to ASTM A36/A36M or ASTM A572/A572M, galvanized, unless otherwise noted.

2.2.4 Concrete

Concrete fill for interior cavity of mooring bollards shall be minimum 5000 pounds per square inch (psi) concrete as specified in Section 03 31 30 MARINE CONCRETE.

2.2.4.1 Grout Bed

Grout used at the base of all mooring hardware shall be non-shrink, non-metallic and have a minimum compressive strength of 8000 psi and a maximum aggregate size of 3/8-inch. For additional grout requirements, refer to Section 03 31 30 MARINE CONCRETE.

2.2.4.2 Non-shrink Grout

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. Grout shall be non-metallic.

2.3 FINISHES

2.3.1 Galvanizing

ASTM A123/A123M or ASTM A153/A153M, as applicable, galvanize all items after fabrication. Hot-dip galvanize items specified to be zinc-coated after fabrication where practicable.

2.3.1.1 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste

material specifically designed for repair of galvanizing, as approved by the Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces and apply material in accordance with manufacturer's instructions. Remove excess material.

2.3.2 Shop Finishing Methods

2.3.2.1 Surface Preparation

Prepare surfaces to be painted and/or coated in accordance with coating manufacturer's recommendations. Wash cleaned surfaces, which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative. Mooring bollards shall be blasted in accordance with SSPC SP 6/NACE No.3 and cleaned of any grease or other foreign matter with a suitable degreaser before applying coatings.

2.3.2.2 Priming and Painting

Apply paint system in accordance with manufacturer's printed instructions. Mooring bollards shall be finished with a three-coat paint system as recommended below. The shop primer shall be applied by the bollard manufacturer prior to delivery. The Contractor shall repair areas of prime coat damaged during handling and installation by surface treatment and application of additional primer or by coating manufacturer's recommendations. The intermediate coat and top coat shall be supplied by the Contractor and applied after final installation of the bollard. Intermediate and top coats shall be in accordance with coating manufacturer's recommendations for harsh, marine environments and shall be approved by the Contracting Officer. Tint the intermediate coat to provide a different color than the top coat. The color of the top coat at the new mooring bollards shall be gloss "black". On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 3.0 mils. Tint the additional prime coat with a small amount of tinting pigment.

Prime Coat (2.0 to 3.0 mils dry film thickness)	Inorganic Zinc
Intermediate Coat (3.0 mils dry film thickness)	Epoxy Paint
Top Coat (2.0 to 2.5 mils dry film thickness)	Acrylic Polyurethane

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Mooring Bollards

Install mooring bollards at locations indicated on the contract drawings and according to manufacturer's instructions. Anchor bolts shall be held in place with templates that match bollard manufacturer's bolt pattern. Templates shall ensure proper location of bolts during placement of concrete. Mooring bollards shall be leveled using shims and secured to bolts using nuts and washers within the bollard base. Nuts shall be hand tight before grouting the base. After grout has cured for 7 days, nuts shall be tightened to the manufacturer's recommended torque. Recesses

around nuts in the bollard base shall be filled with marine grade silicone sealant so as to prevent standing water, 1 inch minimum clear cover of sealant over the anchor rods. To prevent damage to vessel mooring lines, no sharp edges around bolting area shall exist after installation. Provide a minimum of 3 foot clearance from mooring hardware to any utility or fixed structure.

3.1.2 Cleats

Not Used.

3.1.3 Thread Lock Compound

Coat threads of all anchor bolts with a thread lock compound prior to applying washers and nuts. Recoat any anchor bolt thread projection beyond nut after final tightening. Use non-removable thread locking compound on threaded fasteners embedded in concrete.

3.2 FIELD REPAIR

Repair mooring bollard painting system damaged during handling and installation in accordance with coating manufacturer's recommendations and as specified herein to the satisfaction of the Contracting Officer. For repair of zinc-coated or galvanized surfaces see paragraph, "Repair of Zinc-Coated Surfaces."

-- End of Section --

SECTION 40 05 13

PIPELINES, PROCESS PIPING
10/07, CHG 2: 02/20

PART 1 GENERAL

1.1 SCOPE

This section covers all pier utilities piping (except fire protection) including potable water and gravity waste piping.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.34	(2017) Valves - Flanged, Threaded and Welding End
ASME B31.1	(2020) Power Piping
ASME B36.19M	(2004; R 2015) Stainless Steel Pipe

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1013	(2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)
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AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2018) Polyethylene Encasement for Ductile-Iron Pipe Systems

AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2020) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C116/A21.16	(2015) Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray Iron Fittings
AWWA C153/A21.53	(2019) Ductile-Iron Compact Fittings for Water Service
AWWA C213	(2015) Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
AWWA C550	(2017) Protective Interior Coatings for Valves and Hydrants
AWWA C651	(2014) Standard for Disinfecting Water Mains

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A126	(2004; R 2019) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A182/A182M	(2020) Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A194/A194M	(2020a) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A269/A269M	(2015; R 2019) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A312/A312M	(2019) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A395/A395M	(1999; R 2018) Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D3308	(2012; R 2017) Standard Specification for PTFE Resin Skived Tape
ASTM E814	(2013a; R 2017) Standard Test Method for Fire Tests of Penetration Firestop Systems
ASTM F402	(2005; R 2012) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 515	(2017) Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-25	(2018) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 704	(2017) Standard System for the Identification of the Hazards of Materials for Emergency Response
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NSF INTERNATIONAL (NSF)

NSF/ANSI 61 (2020) Drinking Water System Components -
Health Effects

PLASTICS PIPE INSTITUTE (PPI)

PPI TR-21 (2001) Thermal Expansion and Contraction
in Plastic Piping Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2019) Structural Engineering

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910 Occupational Safety and Health Standards

UNDERWRITERS LABORATORIES (UL)

UL 508 (2018) UL Standard for Safety Industrial
Control Equipment

UL 943 (2016; Reprint Feb 2018) UL Standard for
Safety Ground-Fault Circuit-Interruption

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Materials and Equipment

Installation Drawings; G

SD-03 Product Data

Qualifications

Waste Water Disposal

Manufacturer's Field Services

Materials and Equipment; G

Pipe Schedule; G

Valve Schedule; G

Bellow Expansion Joint; G

Axial Expansion Joint; G

Force Balanced Seismic Flexible Expansion Joint; G

SD-06 Test Reports

Hydrostatic Tests

Pneumatic Tests

Valve Testing

Disinfection

SD-10 Operation and Maintenance Data

Piping and Appurtenances; G

1.4 QUALIFICATIONS

1.4.1 Experience

Submit a statement certifying that the Contractor has the specified experience. Contractor shall have successfully completed at least three projects of the same scope and size or larger within the last six years. Demonstrate specific experience in regard to the system installation to be performed.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials delivered and placed in storage must be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of material before, during and after installation is the Contractor's responsibility. Any material found to be damaged must be replaced at the Contractor's expense. During installation, piping must be capped to keep out dirt and other foreign matter. A Safety Data Sheet in conformance with 29 CFR 1910 Section 1200(g) must accompany each chemical delivered for use in pipe installation. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds. Handling must be in accordance with ASTM F402. Storage facilities must be classified and marked in accordance with NFPA 704. Materials must be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage, or other damage. Pipe and fittings must be handled and stored in accordance with the manufacturer's recommendation.

1.6 SEQUENCING AND SCHEDULING

For pier, slab, floor, wall, and roof penetrations, keep on site pertinent wall pipes and sleeves before they are required for placement in concrete forms. Verify and coordinate the size and location of building and structure pipe penetrations before forming and placing concrete.

1.7 MAINTENANCE

1.7.1 Extra Materials

Submit the manufacturer's installation recommendations or instructions for each material or procedure to be utilized, including materials preparation. Concurrent with delivery and installation of the specified piping systems and appurtenances, spare parts for each different item of material and equipment specified that is recommended by the manufacturer

to be replaced any time up to 3 years of service shall be furnished. For each type and size of valve, the following extra materials shall be provided: lubricator, lubricant (with appropriate temperature rating), lubricator/isolating valve. Extra materials shall include 2 of the following spare parts for each type and size of valve: gaskets; O-ring seals; all elastomer parts; stem packing; seat rings and seat ring pulling tool.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

This section covers all above grade pier utilities piping including potable water and gravity waste piping, pipe supports, fittings, equipment and accessories.

2.1.1 Design Requirements

Support systems shall be selected and designed in accordance with MSS SP-58 within the specified spans and component requirements. The absence of pipe supports and details on the contract drawings does not relieve the Contractor of responsibility for sizing and providing supports throughout facility. The structural design, selection, fabrication and erection of piping support system components must satisfy the seismic requirements in accordance with UFC 3-301-01 and Sections 13 48 73 SEISMIC CONTROL FOR MECHANICAL EQUIPMENT.

2.1.2 Performance Requirements

The pressure ratings and materials specified represent minimum acceptable standards for piping systems. The piping systems shall be suitable for the services specified and intended. Each piping system shall be coordinated to function as a unit. Flanges, valves, fittings and appurtenances shall have a pressure rating no less than that required for the system in which they are installed.

2.1.2.1 Above Grade Piping Systems

Piping systems shall be suitable for design conditions, considering the piping both with and without internal pressure, and installation factors such as insulation, support spans, and ambient temperatures. Consideration shall be given to all operating and service conditions both internal and external to the piping systems.

2.2 MATERIALS AND EQUIPMENT

Submit manufacturer's descriptive and technical literature for each piping system, including design recommendations; pressure and temperature ratings; dimensions, type, grade and strength of pipe and fittings; thermal characteristics (coefficient of expansion and thermal conductivity); and chemical resistance to each chemical and chemical mixture in the liquid stream. Provide piping materials and appurtenances as specified and as shown on the drawings, and suitable for the service intended. Piping materials, appurtenances, and equipment supplied as part of this contract shall be of equal material and ratings as the connecting pipe, new and unused except for testing equipment. Components that serve the same function and are the same size shall be identical products of the same manufacturer. The general materials to be used for the piping systems shall be in accordance with TABLE I and are indicated by service

in the Pipe Schedule. Submit a list of piping systems, pressure ratings and source of supply for each piping system broken out by material, size and application as indicated on the contract drawings. A list of any special tools necessary for each piping system and appurtenances furnished for adjustment, operation, maintenance and disassembly of the system. Pipe fittings shall be compatible with the applicable pipe materials.

2.2.1 Standard Products

Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacturing of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit the following: Equipment shop drawings and support system detail drawings showing piping systems and appurtenances, such as mechanical joints, valves, local indicators and hangers, including a complete list of equipment and materials. As-built drawings showing pipe anchors and guides, and layout of piping systems relative to other parts of the work including clearances for maintenance and operation. As-built piping and instrumentation diagrams (P&IDs) identifying and labeling equipment, instrumentation, valves, vents, drains, and all other inline devices; if the contract drawings contained P&IDs, the P&IDs found in the contract drawings shall be revised to reflect the constructed process system, as directed by the Contracting Officer. Nominal sizes for standardized products shall be used. Pipe, valves, fittings and appurtenances shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.2.2 Identification and Tagging

Each piece of pipe shall bear the ASTM designation and all other markings required for that designation. Valves shall be marked in accordance with MSS SP-25 and shall bear an identification tag securely attached using stainless steel wire. Identification tags shall be 1.375 inch minimum diameter, made of stamped stainless steel. The service, valve identification number shown on the Valve Schedule in the contract drawings, the manufacturer's name, and the valve model number shall be displayed.

2.2.3 Installation Drawings

Submit Installation Drawings for pipes, valves and specialties consisting of fabrication, assembly, and support details. Drawings must include the manufacturer's design and construction calculations and must demonstrate supports meet required force and anchor requirements. Drawings must indicate location of expansion joints along with axial, lateral, and angular movements. Drawings must be coordinated with all other trades prior to submission. Coordinate with seismic requirements in Section 13 78 48 SEISMIC CONTROL FOR MECHANICAL EQUIPMENT. Include all notes necessary for installation.

2.3 DUCTILE IRON PIPING SYSTEM

2.3.1 Concrete Lined Ductile Iron Pipe

Concrete lined ductile iron pipe for pressure service shall have a design and wall thickness conforming to AWWA C115/A21.15. Ductile iron pipe shall have a standard cement lining conforming to AWWA C104/A21.4 double thickness. Concrete lined ductile iron pipe shall have a 12 mil thickness

fusion bonded epoxy exterior coating. See Table 1 within Part 3 for piping system service.

2.3.2 Fusion Bonded Epoxy Coated Ductile Iron (Sanitary Sewer)

Fusion bonded epoxy ductile iron pipe for pressure service shall have a design and wall thickness conforming to AWWA C115/A21.15. Ductile iron pipe lining must be a minimum of 12 mil thickness fusion bonded epoxy coating. Pipe must be coated with a fusion bonded epoxy coating with a minimum thickness of 12 mils. See Table 1 within Part 3 for piping system service.

2.3.3 Ductile Iron Joints

Joints shall have a working pressure rating for liquids equal to the pressure rating of the connected pipe. Dielectric fittings or isolation joints shall be provided between all dissimilar metals. Joints must be coated with a fusion bonded epoxy coating with a minimum thickness of 12 mils.

2.3.3.1 Mechanical Joints

Mechanical joints shall conform to AWWA C110/A21.10 and AWWA C111/A21.11. Gaskets, glands, bolts and nuts shall be furnished in sufficient quantity for the complete assembly of each mechanical joint. Glands shall be ductile iron with minimum of 12 mil fusion bonded epoxy or a polyethylene coating. Gaskets shall be nitrile rubber. Housings shall be composed of ductile iron, ASTM A536 and gaskets of molded synthetic rubber, nitrile shall be used. Bolts and nuts for mechanical joints shall be high-strength low-alloy corrosion resistant steel (Corten) with fluoropolymer protective coating and lubrication (blue).

2.3.3.2 Flanged Joints

Flanged joints shall conform to AWWA C110/A21.10. Gaskets, bolts and nuts shall be provided with flanged joints in sufficient quantity for the complete assembly of each joint. Gaskets shall be nitrile rubber. Bolts and nuts for flanged joints shall be Type 316 stainless steel.

2.3.4 Ductile Iron Fittings

Fittings shall be ductile iron AWWA C110/A21.10 or AWWA C153/A21.53. Up to 12 inches inclusive, the fittings shall be 250 psig rated. Gray iron fittings shall be cement mortar lined double thickness with a fusion bonded epoxy coating or fusion bonded epoxy lined and coated to match piping system. Fusion bonded epoxy must have a minimum thickness of 12 mils. Flanges and flanged fittings shall conform to AWWA C110/A21.10 and shall be rated for 150 psig or 250 psig service as required by piping schedule on drawings. Materials shall be ductile iron. For tie-in to existing flanges, field check existing flanges for nonstandard bolt hole configurations and design as required to assure new pipe and flange mate properly. Bolts and nuts shall be as indicated above.

2.3.5 Corrosion Control

Ductile iron piping shall be provided with polyethylene encasement or minimum of 12 mil fusion bonded epoxy in accordance with AWWA C105/A21.5 applied to the outside of pipe and fittings.

2.4 STAINLESS STEEL PIPING SYSTEM (FLOATING DOCK ONLY)

2.4.1 Austenitic Piping

2.4.1.1 Stainless Steel Pipe

Stainless steel pipe intended for general corrosive service shall meet the requirements of ASTM A312/A312M, seamless, Grade TP316L, Schedule 40S in accordance with Pipe Schedule with dimensions conforming to ASME B36.19M.

2.4.1.2 Stainless Steel Tubing

Stainless steel tubing shall meet the requirements of ASTM A269/A269M, seamless, Grade TP316L with nominal size and wall thickness in accordance with Pipe Schedule.

2.4.1.3 Stainless Steel Joints

Stainless steel piping shall be joined by threaded couplings. Dielectric fittings or isolation joints shall be provided between all dissimilar metals.

2.4.1.4 Stainless Steel Threaded Fittings

Threaded fittings shall be austenitic stainless steel, ASTM A182/A182M Grade TP316L, conforming to ASME B16.11, and threaded in accordance with ASME B1.20.1. Polytetrafluoroethylene (PTFE) pipe-thread tape conforming to ASTM D3308 shall be used for lubricant/sealant.

2.4.1.5 Polyethylene Coated Stainless Steel

Provide stainless steel piping serving the floating dock with two part corrosion resistant coating. The coating is to feature an inner adhesive layer with an outer polyethylene coating. The coating must be UV resistant and suitable for waterfront use. Joints and valves are to be protected by petrolatum tape or polyethylene shrink wrap intended for industrial pipeline use in tropical climates.

2.5 ISOLATION JOINTS AND COUPLINGS

2.5.1 Dielectric Fittings

Dielectric fittings shall be provided between threaded ferrous and nonferrous metallic pipe, fittings and valves. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure, temperature and corrosive application.

2.5.2 Isolation Joints

Isolation joints shall be provided between nonthreaded ferrous and nonferrous metallic pipe fittings and valves. Isolation joints shall consist of an isolation gasket of the dielectric type, isolation washers and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with an outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.5.3 Metallic Piping Couplings

Thrust ties shall be provided where shown on the contract drawings and where required to restrain the force developed by 1.5 times the maximum allowable operating pressures specified. For metallic pipe other than ductile iron, thrust ties shall be attached with fabricated lugs. For ductile iron pipe, thrust ties shall be attached with socket clamps against a grooved joint coupling or flange. For exposed installations, zinc-plated nuts and bolts shall be used. However, high-strength, low-alloy steel, in accordance with AWWA C111/A21.11, may be substituted for use on cast iron and ductile iron couplings.

2.5.3.1 Sleeve-Type Couplings

Sleeve-type couplings shall be used for joining plain end pipe sections in a flexible manner with a diameter to properly fit the pipe. A coupling shall consist of one ductile iron middle ring, two ductile iron followers, two elastomeric wedge section gaskets and elliptic-neck, track-head steel bolts designed to properly compress the gaskets. For pipe sizes between 0.5 through 1.5 inch, the followers shall be ductile iron, and the middle ring shall be in accordance with ASTM A395/A395M with AWWA C111/A21.11 bolting. For pipe sizes 2 inch and larger, the followers shall be ASTM A395/A395M, and the middle ring shall be ASTM A395/A395M with AWWA C111/A21.11 bolting. Gaskets shall be ethylene propylene diene monomer (EPDM).

2.5.3.2 Flanged Coupling Adapters

Flanged coupling adapters shall be fully assembled units manufactured to meet ASTM A126 Class B, cast iron. The flanges shall mate with ASME B16.5 Class 150 or 300 flanges as required by system pressure rating, flanges of the same nominal size. A factory applied corrosion resistant coating shall be applied. The coupling shall use natural rubber gaskets. Where pipe movement out of the adaptor may occur, proper anchorage of the pipe shall be provided. The coupling shall be sized to match the associated piping.

2.5.4 Couplings for Nonmetallic Piping

2.5.4.1 Bellows Coupling

A bellows coupling shall have a minimum of two polytetrafluoroethylene (PTFE) convolutions unless otherwise shown, with ductile iron flanged, faced and drilled to ASME B16.5 Class 150 or 300 as required by system pressure rating, end connections, and metal reinforcing bands. Bolting shall be limited to restrain the force developed by 1.5 times the specified maximum allowable operating pressure. The coupling shall be sized to match the associated piping.

2.6 VALVES

2.6.1 General Requirements For Valves

Valves shall include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and all other accessories required for a complete operation. The valves shall be suitable for the intended service. Renewable parts are not to be of a lower quality than those specified. Valves shall be the same size as adjoining pipe. Valve ends shall be compatible with adjacent piping

system. An operator shall be sized to operate the associated valve for the full range of pressures and velocities. Valves will open by turning counterclockwise. Operators, actuators, and accessories shall be factory mounted.

2.6.2 Valve Schedule

Submit a list of valve materials, pressure ratings, valve operator's materials, air supply pressure, electrical service, location, source of supply, and reference identification as indicated in the contract drawings. Provide a list of any special tools necessary for each valve type and appurtenances furnished for adjustment, operation, maintenance and disassembly. Requirements relative to this paragraph are shown in the contract drawings.

2.6.3 Factory Finishing

Valves with cast iron or ductile iron bodies shall have an epoxy lining and coating in accordance with AWWA C550 unless otherwise specified. The epoxy shall be either a two-part liquid material or a heat-activated (fusion) material except that only a heat-activated material shall apply if a valve coating is specified as "fusion" or "fusion bonded" epoxy. The epoxy lining and coating shall have a minimum 7.0 mils dry film thickness except where it is limited by valve operating tolerances.

2.6.4 Check Valves

2.6.4.1 Swing Check Valves

Swing check valves shall conform to the following:

- a. Swing check valves, 2.5 inches through 12 inch, shall have a ductile iron body, in accordance with ASME B16.5 flanged ends. Valves shall have a bronze-mounted swing type, bronze disc, solid bronze hinges, and stainless steel hinge shaft. Valves shall be rated for 200 psig service.

2.6.5 Ball Valves

2.6.5.1 Multiple Piece Body Ball Valves

Multiple piece body ball valves, 0.5 to 1.5 inch, shall have three piece bodies constructed of stainless steel ASTM A276/A276M Grade TP316 stainless steel. Valves shall have a TP316 stainless steel ball, and ASME B16.11 threaded end connections. Valves shall be rated for 1000 psig service and shall conform to ASME B16.34 Class 150. Valves shall have reinforced polytetrafluoroethylene (PTFE) seats and stem packing, shall be full bore, and shall be equipped with hand lever operators.

2.6.6 Plug Valves

2.6.6.1 Lined Eccentric Valve

Nonlubricated type eccentric valves, 3 through 54 inch, shall be rated for 175 psig service at 140 degrees F. Valves shall have drip-tight shutoff with pressure from either direction, and bronze bodies in accordance with ASME B16.1 flanged end connections. Plugs shall be cast iron with round ports of no less than 80 percent of the connecting pipe area polyethylene. Valves shall have stainless steel seats,

self-lubricating stainless steel stem bearings, and multiple V-rings stem seals nitrile rubber grit seals on the stems. Valves 6 inch and smaller shall have a wrench lever manual operator¹. Valves shall conform to ASME B16.34 Class 125.

2.6.7 Butterfly Valves

2.6.7.1 Standard Service Butterfly Valve

Butterfly valves, 2 inch and larger, shall have MSS SP-67 and NSF 61 ductile iron bodies, lugged styled with ASME B16.5 flanged end connections. Valves shall conform to Class 125. Discs shall be contoured stainless steel with EDPM seal. The valve shafts shall be stainless steel with self-lubricating, corrosion-resistant sleeve type bearings. Valve seats for 24 inch and smaller valves shall be attached to either the valve body or the disc and shall be constructed of chloroprene. Valves shall have manual, locking hand lever operators.

2.6.8 Operators

2.6.8.1 Manual Operator

The force in a manual operator shall not exceed 39.3 pound under any operating condition, including initial breakaway. The operator shall be equipped with gear reduction when force exceeds 39.3 pound. The manual operator shall be a self-locking type or shall be equipped with a self-locking device. A position indicator shall be supplied on quarter-turn valves. Worm and gear operators shall be a one-piece design with worm-gears of gear bronze material. Worm shall be hardened alloy steel with the thread ground and polished. Traveling nut type operators shall have threader steel reach rods with an internally threaded bronze or ductile iron nut.

2.6.8.1.1 Exposed Operators

Exposed operators shall have galvanized and painted handwheels. Lever operators are allowed on quarter-turn valves 8 inch and smaller. Cranks shall be supplied on gear type operators. If located off of the operator floor, chain wheel operator with tiebacks, extension stem, floor stands, and other accessories shall be provided to permit operation from normal operation level. Valve handles shall be capable of padlocking, and wheels shall be lockable with a chain and padlock.

2.7 DRAINS

Valved drains may not be shown on the detailed drawings for individual pipelines; their absence will not relieve the Contractor of the responsibility for providing and installing them as indicated in the piping and instrumentation diagrams to complete the piping system for the use intended.

2.7.1 Locations

Drains shall be located as indicated on the contract drawings and provided at all pipeline low points even if not shown on the contract drawings.

2.7.2 Sizes

For pipelines 2.5 inch and larger, drains shall be 0.75 inch and equipped

with ball valves. For pipelines 2 inch and smaller, drains shall be 1/2 inch and equipped with ball valves.

2.8 SAMPLE PORTS

Sample ports, shown on the flow diagrams and piping and instrument diagrams of the contract drawings, may not be shown on the detailed drawings of the individual pipelines; their absence shall not relieve the Contractor of the responsibility for providing them. The sample ports shall be located in easily accessible locations, and shall avoid potential stagnant points and/or areas where material could collect. Sampling ports shall be comprised of pipe fittings, pipe, and ball valves which comply with material, temperature, and pressure requirements of the associated piping system as specified elsewhere in this Section.

2.9 MISCELLANEOUS PIPING COMPONENTS

2.9.1 Backflow Preventer

The backflow preventer shall be identical in size to pipe. Total head loss through the complete backflow assembly shall not exceed 13 psi at rated flow.

2.9.1.1 Stainless Steel Reduced Pressure Backflow Preventer

The assembly body shall be two independent 304 stainless steel body check valves rated at a minimum 150 psig at 140 degrees F, with an intermediate relief valve, and isolation gate valve, as testing cocks. All internal parts shall be serviceable in-line. The reduced pressure backflow prevention assembly shall be rated for a minimum 150 psig working pressure at 150 degrees F. The assembly body shall be in accordance with ASSE 1013.

2.9.2 Expansion Joints

Provide all structural work and equipment required to control expansion and contraction of piping. Verify that the anchors, guides, and expansion joints provided, adequately protect the piping systems.

2.9.2.1 Bellow Expansion Joint

The rubber expansion joint shall have a multiple wide flowing arch. This profile provides exceptional all directional movement while virtually eliminating sediment buildup. The inner tube shall be a seamless, leak-proof layer of nominal 1/4 inch thickness that extends from the outside diameter of one flange to the outside diameter of the other flange. It shall be an elastomer compatible with the fluid media and service temperature. The textile reinforcement shall be a minimum of six bias plies of high quality tire-cord reinforcement, having an adhesion promoting resorcinol formaldehyde latex (RFL) coating and impregnated (skimmed) with a compatible elastomer to ensure a homogeneous bonding to other layers. The metal reinforcement shall have sufficient radial strength to support the textile loads. It shall be high-tensile steel to keep weight and volume down to optimize flexibility. The metal reinforcement shall be round to prevent cutting of the textile reinforcement. The exterior cover shall be a seamless layer, of nominal 1/16 inch thickness. It shall be an elastomer compatible with the external environment. Provide an additional exterior coating to improve external weathering protection. Rubber flanges shall be integral with the body and have a full flat face with the same outside diameter as the

mating flange. Flanges shall be drilled to Class 150 lb. Retaining rings shall be fabricated of minimum 3/8 inch thickness ductile iron with hot dipped galvanized finish.

2.9.2.2 Axial Expansion Joint

Expansion joints shall be installed in the locations indicated on the drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request. Each expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 PSI for 4-inch through 12-inch. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply. Each expansion joint shall have 8-inches minimum expansion. The expansion fitting shall not expand or exert an axial imparting thrust under internal water pressure. The expansion fitting shall not increase or decrease the internal water volume as the unit expands or contracts. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet NSF/ANSI 61. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

2.9.2.3 Force Balanced Seismic Flexible Expansion Joint

Flexible expansion joints shall be installed in the locations indicated on the drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 PSI for 3 inch through 16 inch and 250 PSI for 18 inch and greater. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20 degrees for sizes 4-inch through 12-inch; 15 degrees for sizes 14-inch through 36-inch and 12 degrees for size 48-inch. The flexible expansion fitting shall not expand or exert an axial imparting thrust under internal water pressure. The flexible expansion fitting shall not increase or decrease the internal water volume as the unit expands or contracts. The minimum total linear travel shall be 8-inches. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet NSF/ANSI 61. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

2.10 PIPE SUPPORTS AND PENETRATIONS

Provide auxiliary steel where the support of piping systems and equipment is required between building structural elements. Light gauge and structural steel shapes shall conform to the requirements of ASTM A36/A36M. The Contractor has the option to use pre-engineered support systems of electrogalvanized steel products. However, a mixture of support system manufacturers products is not permitted. Where auxiliary steel is indicated as stainless steel, provide TP316L ASTM A167, No. 1 Finish.

2.10.1 Pipe Supports

Pipe supports shall conform to the requirements of MSS SP-58. Where pipe supports contact bare piping or in-line devices, provide supports of compatible material so that neither shall have a deteriorating action on the other. All pipe supports shall be 316 stainless steel ASTM A167.

2.10.1.1 Brackets

Where piping is run adjacent to walls or steel columns, provide welded 316 stainless steel ASTM A167 brackets, pre-punched with a minimum of two fastener holes.

2.10.1.2 Offset Pipe Clamp

Where pipes are indicated as offset from wall surfaces, supply a double-leg design two-piece pipe clamp. Offset pipe clamps shall be 316 stainless steel ASTM A167.

2.10.1.3 Racks

Multiple pipe racks hangers shall be fabricated from 316 stainless steel ASTM A167, and designed to suit the conditions at the points of installation. Pipes shall be kept in their relative positions to each other by the use of clamps or clips. Pipelines subject to thermal expansion must be free to slide or roll.

2.10.1.4 Hold Down Strap

Hold down strap shall have threaded rod style end connections. Strap width shall be a minimum of 1-3/4 inch. Hold down strap shall be provided with a polyurethane liner to ensure that delamination does not occur. All hold straps, threaded rods and nuts shall be 316 stainless steel ASTM A167.

2.10.1.5 Wear Pad

Wear pad inside diameter (ID) shall precisely matches outer diameter of pipe. Wear pad ID shall be pre-roughened for exceptionally high epoxy-to-wear-pad bonding strengths as verified by ASTM D5528-01. Temperature range shall be: -320°F to +400°F. Wear pad shall be comprised of vinyl ester resin that is fire retardant (certified to meet ASTM E-84 flame spread "Class 2" rating less than 75 on Flame Spread Index). UV inhibitors shall be added to wear pad resin (light stabilizer that protects resin from long-term degradation effects from ultraviolet light).

2.10.2 Wall Penetrations

2.10.2.1 Above Grade Wall Penetrations

Piping which passes through fire-rated or smoke-rated walls, floors, or ceilings shall be provided with insulated and encased pipe sleeves. Penetrations through an existing fire or fire barrier wall shall be sealed with a fire stop system that has an "F" rating not less than the required fire resistance rating of the penetrated wall. The fire stopping sealant for metal piping systems shall be vibration resistant, polysiloxane (also known as silicone) based, nonslumping, premixed sealant with intumescent properties, that is rated for 3 hours pursuant to ASTM E814 and UL requirements.

2.10.2.2 Below Grade Wall Penetrations

Below-grade wall penetrations shall be provided with hydrostatic seals designed to seal opening between pipe or conduit and a through-structure opening. The seals shall be modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening.

2.10.2.3 Galvanizing

Galvanizing shall be hot-dip applied and meet the requirements of ASTM A153/A153M. 316L stainless steel components may be substituted where galvanizing is specified.

2.11 MISCELLANEOUS MATERIALS

2.11.1 Pipe Insulation Material

Insulation for pipes, valves, instrumentation and controls, and other equipment shall be in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.11.2 Electric Heat Trace System

Provide heat trace system consisting of a control panel and self-regulating, parallel resistance heating cables to maintain 40 degrees F piping temperature at 0 degrees F ambient temperature with a 8.5 mph wind and a 10 percent safety factor for pier utilities as indicated on drawings. Contractor to provide sizing calculations for all required piping utilities. Refer to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS for insulation thickness and material properties.

2.11.2.1 Self-Regulating, Parallel-Resistance Heating Cables

- a. Heating Element: Pair of parallel No. 16 AWG, nickel-coated stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating. Self-regulating heating cable shall be designed for a useful life of a minimum of 20 years with "power on" continuously.
- b. Electrical Insulating Jacket: Flame-retardant polyolefin.
- c. Cable Cover: Tinned-copper, and polyolefin outer jacket with UV inhibitor.
- d. Maximum Operating Temperature (Power On): 150 degrees F.
- e. Maximum Exposure Temperature (Power Off): 185 degrees F.
- f. Capacities and Characteristics:
 - (1) Minimum Heat Output: 6 W/ft.
 - (2) Piping Diameter: As indicated on the Drawings.

(3) Number of Parallel Cables: As required to maintain specified conditions.

(4) Volts: 480V.

(5) Phase: 3.

(6) Hertz: 60.

(7) Maximum System Ampacity: 40 A.

(8) Provide number of heat trace circuits as required to heat trace all exterior water piping systems. Heat Trace circuits must be limited to 100 feet maximum. Terminate all heat trace circuits in the heat trace control panel.

2.11.2.2 Heat Trace Control Panel

Heat Trace Panel with NEMA 4X enclosure, Incoming main disconnect, 480 volt, three phase, Common Alarm Output, Hand/Off/Auto Operation, integral 120 Volt Instrument Power, Current Monitoring, Ground Fault Equipment Protection, UL 508 construction and Thermostat Controlled Enclosure Heater for panel freeze protection down to 0 degrees F ambient. Provide BACnet communication interface to building control system specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC to communicate common alarms, current monitors for each heat trace circuit, and ground faults.

2.11.3 Hot Box

Hot type shall be durafold type enclosure with top and side accessible. Drain ports shall be sized for full port backflow discharge be designed for a one way operation allowing backflow discharge but not allow wind, debris and small animals to enter the enclosure. Enclosure shall be designed to support a minimum vertical load of 100lb/sf. Enclosure shall be designed to support wind speeds up to 80mph. Enclosure shall be ASSE 1060 certified.

2.11.3.1 Materials

Aluminum sheeting shall be 3003 aluminum 18 gauge, stucco embossed finish and shall meet ASTM B209. Stucco embossed finish reduces the glare and helps hide any surface scratches or imperfections received in the field. Bracing shall be 6063-T52 aluminum and shall meet ASTM B221. No wood or particle board used in the construction of any Hot Box product. Anchor pads shall be galvanized steel. Insulation shall be approximately 1.5 inch unicellular, non-wicking, polyisocyanate foam sprayed in place that forms a monolithic bond between the aluminum bracing and aluminum sheeting.

The Insulation shall have the following properties:

- a. R-Value: 10
- b. Dimensional Stability less than 2% linear change
- c. Compressive Strength 51 psi
- d. Flame point 325 degrees
- e. Water absorption .037 psf
- f. Porosity 91%

2.11.3.2 Electric Heating (ASSE 1060 Class I-Required)

Heating will protect the piping and equipment from exterior temperatures to -30 degrees F. ETL listed thermostatically controlled wall mounted air forced heaters or UL listed self regulating cable(s) shall be furnished and designed by the manufacturer of the enclosure to maintain the equipment at +40 F, in accordance with ASSE 1060 1.2.2.1. Heating equipment shall be wall mounted to the supplied heater plates and a minimum 8 inches above the slab unless it is UL or ETL certified and NEC approved for submersion. Power source shall be protected with a GFI receptacle, UL 943, NEMA 3R. Mounted a minimum of 8 inches from the bottom of the receptacle to the top of the slab. Separate 20 amp circuits are recommended for each heater, so in the event a circuit fails all other circuits will remain powered. Installations must be in accordance with the local and national codes. The heaters shall be ETL listed for wet/damp locations.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 PREPARATION

3.2.1 Protection

Pipe and equipment openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage.

3.2.2 System Preparation

3.2.2.1 Pipe and Fittings

Pipe and fittings shall be inspected before exposed piping is installed or buried piping is lowered into the trench. Clean the ends of pipes thoroughly, remove foreign matter and dirt from inside of pipes, and keep piping clean during and after laying.

3.2.2.2 Damaged Coatings

Repair damaged coating areas in the field with material equal to the original coating, except for damaged glass-lined pipe which shall be promptly removed from the site. Do not install damaged piping materials. Field repair of damaged and uncoated areas of galvanized piping shall conform to ASTM A780/A780M.

3.2.2.3 Field Fabrication

Notify the Contracting Officer at least 2 weeks prior to the field fabrication of pipe or fittings and at least 3 days prior to the start of any surface preparation or coating application work. Fabrication of fittings shall be performed in accordance with the manufacturer's instructions.

3.3 EXPOSED PIPING INSTALLATION

Exposed piping shall be run as straight as practical along the alignment shown on the contract drawings and with a minimum of joints. Piping and appurtenances shall be installed in conformance with reviewed shop drawings, manufacturer's instructions and ASME B31.1. Piping shall be installed without springing or forcing the pipe.

3.3.1 Anchors and Fasteners

Impact expansion (hammer and explosive charge drive-type) anchors and fastener systems are not acceptable. Lead shields, plastic or fiber inserts, and drilled-in plastic sleeve/nail drive systems are also not acceptable. All anchors and fasteners on the pier shall be 316L stainless steel.

3.3.1.1 Drilled-In Expansion Anchors and Fasteners

Anchors shall be designed to accept both machine bolts and/or threaded rods. Such anchors shall consist of an expansion shield and expander nut contained inside the shield. The expander nut shall be fabricated and designed to climb the bolt or rod thread and simultaneously expand the shield as soon as the threaded item, while being tightened, reaches, and bears against the shield bottom. The shield body shall consist of four legs, the inside of each shall be tapered toward shield bottom (or nut end). The end of one leg shall be elongated and turned across shield bottom. The outer surface of shield body shall be ribbed for grip-action. The expander nut shall be of square design with sides tapered inward from bottom to top. The anchor materials of construction shall be TP316L stainless steel of 43,541 psi minimum tensile strength. Fasteners shall be machine bolts for use with above anchors; nuts and washers shall conform to ASTM A194/A194M. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application. The anchor/fastener assembly shall be UL listed with a one-piece stud (bolt) that has integral expansion wedges, nuts and washers. The stud shall be constructed of TP304 stainless steel, and nut and washer of TP316L stainless steel. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application.

3.3.1.2 Drilled-In Adhesive Anchors

Drilled-in adhesive anchors shall not be used for overhead applications. The anchors shall be composed of an anchor rod assembly and an anchor rod adhesive cartridge. The anchor rod assembly shall be a chamfered and threaded stud rod of TP316L stainless steel with a nut and washer of TP316 stainless steel. The anchor length, diameter, and embedment depth shall meet the manufacturer's requirements for the maximum allowable working load of the application. The adhesive cartridge shall be a sealed capsule containing premeasured amounts of resin, quartz sand aggregate, and a hardener contained in a separate vial within the capsule. The capsule ingredients shall be activated by the insertion procedure of the anchor rod assembly.

3.3.2 Piping Expansion and Contraction Provisions

The piping shall be installed to allow for thermal expansion and contraction resulting from the difference between installation and operating temperatures. Design for installation of plastic pipe exposed

to ambient conditions or in which the temperature variation of the contents is substantial shall have provisions for movement due to thermal expansion and contraction documented to be in accordance with PPI TR-21. Anchors shall be installed as shown in the contract drawings to withstand expansion thrust loads and to direct and control thermal expansion. An intermediate pipe guide shall be installed for every pipe at each metal channel framing support not carrying an anchor or alignment guide. Where pipe expansion joints are required, pipe alignment guides shall be installed adjacent to the expansion device and within four pipe diameters. Expansion devices shall be installed in accordance with the manufacturer's instructions and at the locations shown in the contract drawings.

3.3.3 Piping Flexibility Provisions

Thrust protection shall be provided as required. Flexible couplings and expansion joints shall be installed at connections to equipment, and where shown on the contract drawings. Additional pipe anchors and flexible couplings beyond those shown on the contract drawings, shall be provided to facilitate piping installation, in accordance with reviewed shop drawings.

3.3.4 Couplings, Adapters and Service Saddles

Pipes shall be thoroughly cleaned of oil, scale, rust, and dirt in order to provide a clean seat for gaskets. Gaskets shall be wiped clean prior to installation. Flexible couplings and flanged coupling adapter gaskets shall be lubricated with soapy water or the manufacturer's standard lubricant before installation on the pipe ends. Couplings, service saddles, and anchor studs shall be installed in accordance with manufacturer's instructions. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Torque-limiting wrenches shall be used to tighten bolts.

3.3.5 Piping Equipment/Component Installation

Piping components and indicators shall be installed in accordance with manufacturer's instructions. Required upstream and downstream clearances, isolation valves, and miscellaneous devices shall be provided for an operable installation.

3.3.5.1 Backflow Preventers

Backflow preventers shall be installed with nameplate and test cocks accessible from front of unit, and with a minimum clearance of 12.2 inches between the port and grade. The assemblies shall be installed in accordance with local codes and shall discharge to an open drain with an air gap; vertical installation.

3.3.5.2 Local Indicators

All direct-reading indicator devices, thermometers, and pressure gauges shall be installed so that they can be easily read from floor level, and are readily accessible for maintenance and service. All temperature sensing bulbs shall be coated with a silver base heat transfer grease prior to insertion into the thermowell. Pressure gauges and thermometers shall be installed where indicated in the contract drawings. Field calibration of all indicators shall be performed at time of installation

to ensure measuring and reading accuracy. Differential pressure gauges shall be installed across all process equipment, in accordance with the manufacturer's recommendations, and arranged for easy observation.

3.3.6 Pipe Flanges

Pipe flanges shall be set level, plumb, and aligned. Flanged fittings shall be installed true and perpendicular to the axis of the pipe. The bolt holes shall be concentric to the centerline of the pipe and shall straddle the vertical centerline of the pipe.

3.3.7 Valve Locations

Valves shall be located in accordance with the contract drawings where actuators are shown. Where actuators are not shown, valves shall be located and oriented to permit easy access to the valve operator, and to avoid interferences.

3.3.8 Pipe Tap Connections

Taps to pipe barrels are unacceptable. Taps to ductile iron piping shall be made only with a service saddle or at a tapping boss of a fitting, valve body, or equipment casting.

3.3.9 Insulation

Insulation shall be installed on piping as indicated in the contract drawings in accordance with the provisions of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.4 CONNECTING DISSIMILAR PIPE

Flexible transition couplings, dielectric fittings and isolation joints shall be installed in accordance with the manufacturer's instructions.

3.5 EXTERNAL CORROSION PROTECTION

Protect all pipe and piping accessories from corrosion and adverse environmental conditions.

3.5.1 Above Grade Metallic Piping

Nonferrous and stainless steel piping shall not be painted except for aluminum alloy piping. Where dissimilar metals are joined, isolation joints shall be used.

3.5.1.1 Ferrous Piping

Shop primed surfaces shall be touched up with ferrous metal primer. Surfaces that have not been shop primed shall be solvent cleaned. Surfaces that contain loose rust, mill scale or other foreign substances shall be mechanically cleaned by power wire brushing and primed with a ferrous metal primer. Primed surfaces shall be finished with two coats of exterior oil paint in accordance with Section 09 90 00 PAINTS AND COATINGS.

3.6 FLEXIBLE JOINTS AT CONCRETE STRUCTURES

Flexible joints shall be provided at the face of all structures, whether or not shown on the contract drawings. Rubber ring joints, mechanical

joints, flexible couplings, and proprietary restrained ductile iron pipe joints shall be considered flexible joints; welded pipe joints shall not. Joints may be flush with the structure face or may be located up to 1 pipe diameter away from face, but not further than 17.7 inches.

3.7 CLOSURES

Closure pieces shall be installed as necessary to end pipe runs and shall conform to ASME B16.9 or ASME B16.11. Elastomer sleeves bonded to pipe ends are not acceptable. Pressure piping shall have closures of flanged plain end pieces, with thickness matching the nominal wall thickness of the associated pipe, mounted on double flexible couplings, unless otherwise shown on contract drawings or approved by the Contracting Officer. Pipes with restrained joints shall have pipe closures installed with thrust tie-rod assemblies.

3.8 PENETRATIONS

Steel pipe sleeves shall be hot-dipped galvanized after fabrication for above grade applications in nonsubmerged areas. Wall pipes shall be securely supported by form work to prevent contact with reinforcing steel and tie-wires. Joints shall be caulked with rubber sealant.

3.9 VALVE INSTALLATION

Flanged valve bolt holes shall be installed so as to straddle the vertical centerline of pipe. Flanged faces shall be cleaned prior to inserting the gasket and bolts, and then the nuts shall be tightened progressively and uniformly. Threaded ends shall have the threads cleaned by wire brushing or swabbing prior to installation.

3.9.1 Valve Orientation

The operating stem of a manual valve shall be installed in a vertical position when the valve is installed in horizontal runs of pipe having centerline elevations 4.5 feet or less above finished floor, unless otherwise shown on contract drawings. The operating stem of a manual valve shall be installed in a horizontal position in horizontal runs of pipe having centerline elevations between 4.5 feet and 6.75 feet above finish floor, unless otherwise shown on contract drawings. Automatic valves shall be installed in accordance with the manufacturer's instructions and approved drawings.

3.9.1.1 Butterfly Valves

Orientation of butterfly valves shall take into account changes in pipe direction. Valve shafts shall be oriented so that unbalanced flows caused by pipe direction changes or other disturbances are equally divided to each half of the disc.

3.9.1.2 Plug Valves

If a plug valve seat position is not shown in the contract drawings, locate the seat position as follows: for horizontal flow, the flow shall produce an "unseating" pressure, and the plug shall open into the top half of valve; and for vertical flow, the seat shall be installed in the highest portion of the valve.

3.9.2 Line Size Ball Valves

A line size ball valve and union shall be installed upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding, for isolation during maintenance.

3.9.3 Isolation Valve

Safety isolation valves shall be installed on compressed air supplies. The valve shall be located to provide accessibility for control and maintenance. If necessary, access doors shall be installed in finished walls and plaster ceilings for valve access.

3.9.4 Torque Tube

Where the operator for quarter-turn valve is located on a floor stand, an extension stem torque tube shall be furnished, properly sized for the maximum torque capacity of the valve.

3.10 AIR RELEASE, DRAINS AND SAMPLE PORTS

Sample ports shall be provided where indicated on the contract drawings. Install specified vents at piping high points for entrapped air release and install drains in the low points of pipelines regardless of whether shown on contract drawings.

3.11 PIPING SUPPORT SYSTEMS INSTALLATION

The absence of pipe supports and details on the contract drawings shall not relieve the Contractor of responsibility for sizing and providing supports throughout plant.

3.11.1 General Support Requirements

Pipe support systems shall meet the requirements of MSS SP-58, piping support system components must satisfy the seismic requirements in accordance with UFC 3-301-01 and Sections 13 48 73 SEISMIC CONTROL FOR MECHANICAL EQUIPMENT. Contractor-designed and selected support systems shall be installed in accordance with MSS SP-58, and as specified herein. Piping connections to equipment shall be supported by pipe supports and not off the equipment. Large or heavy valves, fittings, and/or equipment shall be supported independently of associated piping. Pipes shall not be supported off other pipes. Supports shall be provided at piping changes in direction or in elevation, adjacent to flexible joints and couplings, and where otherwise shown on the contract drawings. Pipe supports and hangers shall not be installed in equipment access areas or bridge crane runs. Hanging pipes shall be braced against horizontal movement by both longitudinal and lateral sway bracing. At each channel type support, every pipe shall be provided with an intermediate pipe guide, except where pipe anchors are required. Existing support systems may be used to support additional new piping only if the Contractor can demonstrate that the existing support systems are adequate for the additional loads, or if the existing systems are strengthened to support the additional loads. Pedestal type pipe supports shall be provided under base flanges adjacent to rotating equipment and where required to isolate vibration. Piping 2.5 inch in diameter and larger shall be braced for seismic forces. Lateral supports for seismic loads shall be installed at all changes in direction.

3.11.2 Support of Insulated Piping

Install oversized supports to fit the insulation inserts. Supports shall be provided with galvanized or stainless steel protection shields and oversized rollers.

3.11.3 Dielectric Barriers

Dielectric barriers shall be installed between supports and copper or stainless steel piping, and between stainless steel supports and non-stainless steel ferrous piping.

3.11.4 Support Methods

Piping support shall be provided as specified and as shown in the contract drawings. Horizontal pedestal mounted piping shall have saddle type supports. Horizontal wall mounted piping shall have wall brackets.

3.11.5 Supports and Hangers for Stainless Steel Piping

All hanger-pipe contact surfaces shall have a dielectric barrier consisting of chloroprene rubber. The load rating of universal concrete inserts shall not be less than that of the hanger rods they support.

3.12 HEAT TRACE CABLE INSTALLATION

Field apply heater tape and cut to fit as necessary, linearly along the length of pipe after piping has been pressure tested and approved by the Contracting Officer. Secure the heater to piping with either cable ties or fiberglass tape. Label thermal insulation on the outside, "Electrical Heat Trace".

Install power connection, end seals, splice kits and tee kit components in accordance with IEEE 515 to provide a complete workable system. Terminate connection to the thermostat and ends of the heat tape in a junction box. Ensure cable and conduit connections are raintight.

3.13 PIPE IDENTIFICATION, PAINTING AND COLOR CODING

Color, coating, and lettering requirements for exposed piping shall be in accordance with Section 09 90 00 PAINTS AND COATINGS.

3.14 FIELD QUALITY CONTROL

3.14.1 Hydrostatic Tests

Where any section of a pipeline is provided with concrete thrust blocking for fitting, the hydrostatic tests shall not be made until at least 5 days after the installation of the concrete thrust blocking, unless otherwise approved by the Contracting Officer.

3.14.1.1 Exposed Piping

Hydrostatic testing shall be conducted in accordance with ASME B31.1. Piping systems shall be tested under normal service conditions (as indicated in the Pipe Schedule in the contract drawings) to demonstrate compliance. The test pressure shall not be less than 1.5 times the design pressure. Water shall be used as the hydrostatic test fluid. Provide clean test water of such quality to prevent corrosion of the piping system

materials. Air release vents shall be opened at all high points of the piping system in order to purge air pockets while the piping system is filling.

3.14.1.1.1 Rigid Piping

For rigid piping hydrostatic testing, the maximum test pressure shall be calculated according to ASME B31.1, but shall not exceed the yield strength of the piping system. The maximum velocity during filling shall be 0.25 fps applied over full area of pipe. Test all parts of the piping system. The hydrostatic test pressure shall be maintained continuously for 30 minutes minimum and for such additional time as necessary to conduct examinations for leakage. All joints and connections shall be examined for leakage. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leaking. Correct visible leakage and retest. Unless otherwise directed by the Contracting Officer, the piping system shall be left full of water after leaks are repaired.

3.14.1.2 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a delay, underground piping jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Tests for above ground pressure piping shall be conducted after the piping has been completely installed, including all supports, hangers, and anchors, and inspected for proper installation but prior to installation of insulation.

3.14.2 Pneumatic Tests

Pneumatic testing shall be prepared for and conducted in accordance with the requirements of ASME B31.1. Care must be taken to minimize the chance of a brittle fracture or failure during a pneumatic leak test. Only non-toxic, nonflammable, inert gases or air shall be used.

3.14.2.1 Pressure Relief Device

During pneumatic testing, a pressure relief device shall be provided for each piping section being tested. The device shall have a set pressure not higher than the test pressure plus the lesser of 10 percent of the test pressure or 50 psi over test pressure.

3.14.2.2 Pneumatic Testing Procedures

The test fluid shall be air and the test pressure shall be 110 percent of the design pressure. The test pressure shall be incrementally increased until the gage pressure reaches the lesser of 50 percent of the test pressure or 25 psig. Examine piping joints for leakage. If no leakage is occurring, continue to increase the pressure incrementally, while maintaining each incremental increase long enough to equalize pipe strains, until the test pressure is reached. The test pressure shall then be reduced to the design pressure and maintained for 60 minutes without additional energy expenditure. If the pneumatic pressure remains steady, then no leakage is indicated. Inspect for and repair leaks, and retest if necessary.

3.14.3 Valve Testing

Submit copies of all field test reports within 24 hours of the completion of the test. Valves may either be tested while testing pipelines, or as a separate step. It shall be demonstrated that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, and in both directions for two-way valve applications. Count and record the number of turns required to open and close each valve, and account for any discrepancies with manufacturer's data. Air and vacuum relief valves shall be examined as the associated pipe is being filled to verify venting and seating is fully functional. Set, verify, and record set pressures for all relief and regulating valves. Self-contained automatic valves shall be tested at both maximum and minimum operating ranges, and reset upon completion of test to the design value.

3.15 FINAL CLEANING

3.15.1 Interim Cleaning

Prevent the accumulation of pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping sections during fabrication. The piping shall be examined to assure removal of these and other foreign objects prior to assembly and installation.

3.15.2 Flushing

Following assembly and testing, and prior to final acceptance, piping systems shall be flushed with water to remove accumulated construction debris and other foreign matter. The piping shall be flushed until all foreign matter is removed from the pipeline. Provide all hoses, temporary pipes, ditches, and other items as required to properly dispose of flushing water without damage to adjacent properties. The minimum flushing velocity shall be 2.5 fps. For large diameter pipe where it is impractical to flush the pipe at the minimum flushing velocity, the pipeline shall be cleaned in-place from the inside by brushing and sweeping, then flushing the pipeline at a lower velocity. Cone strainers shall be installed in the flushing connections of attached equipment and left in place until cleaning is completed. Accumulated debris shall be removed through drains, or by removing spools or valves.

3.15.3 Disinfection

Disinfect the following pipelines: potable water. Before acceptance of piping system operation, each section of completed pipeline shall be disinfected in accordance with AWWA C651. After pressure tests have been made, the piping section to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be liquid chlorine. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the piping in an approved manner. In no case shall the agent be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. All valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing

period, each outlet on the line shall be opened and closed several times. From several points in the pipeline section, Contractor personnel, approved by the Contracting Officer, shall take samples in sterilized containers and have a bacterial examination performed by a commercial laboratory in accordance with state approved methods. The commercial laboratory must be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until the piping system passes the bacterial examination for 2 consecutive days. The piping system will not be accepted until satisfactory bacteriological results have been obtained.

3.16 WASTE WATER DISPOSAL

Submit the method proposed for disposal of waste water from hydrostatic tests and disinfection, and all required permits, prior to performing hydrostatic tests. The water used for testing, cleaning, flushing and/or disinfection shall be disposed of in accordance with all applicable regulations. Disposal is solely the responsibility of the Contractor. The method proposed for disposal of waste water shall be provided to, and approved by, the Contracting Officer prior to performing any testing, cleaning, flushing and disinfection activities.

3.17 TABLES

TABLE I PIPE AND FITTING MATERIALS FOR COMMON PIPING SYSTEMS			
Item No.	Pipe Material	SERVICE	
		A	B
2.2	Epoxy Coated Epoxy Lined DI		x
2.3	Double Cement Lined Epoxy Coated DI	x	
LEGEND:			
A	Potable Water		
B	Sanitary Sewer		

3.18 MANUFACTURER'S FIELD SERVICES

Submit a signed statement certifying that the installation is satisfactory and in accordance with the contract drawings and specifications and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance. Obtain manufacturer's technical assistance for Contractor training, installation inspection, start up, and owner operating and maintenance training. Follow manufacturer's instructions for installation.

-- End of Section --

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